Vol. XV No. 5

DISSERTATION ABSTRACTS

A GUIDE TO DISSERTATIONS AND MONOGRAPHS AVAILABLE IN MICROFORM

UNIVERSITY MICROFILMS
ANN ARBOR, MICHIGAN: 1955

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AGRICULTURE, GENERAL

AN ANALYSIS OF BEEF CATTLE PRICES

(Publication No. 11,613)

James Wayland Bennett, Ph.D.
Louisiana State University, 1955

Director: Professor Martin D. Woodin

This study was undertaken to present a description and analysis of cattle price behavior from 1867 to 1954. Through an analysis of past price movements and factors associated with them, the cattle industry, including the agencies that handle and process livestock, is in a better position to appraise its present position, formulate programs and make decisions affecting its further development.

The procedure followed was to describe the various types of price movements, attempting to isolate and analyze the principal factors associated with each type. Emphasis was placed on the timing of price changes, duration of the changes in any given direction, and the magnitude of the changes. An effort was made to isolate and explain deviations from the expected or "normal" price pattern. Data from secondary sources, primarily statistics of the United States Department of Agriculture, supplemented by the results of price research by public and private agencies were used in the analysis. Such a study involves both a deductive and inductive approach and is subject to the advantages and disadvantages of these techniques.

The conclusions reached are: (1) The long-time trend in cattle prices is upward, being closely related to the economic development of the country. (2) Cattle prices tend to rise and fall in line with increases or decreases in the general price level, lagging slightly behind. (3) As economic activity increased there was a corresponding increase in per-capita income which tended to exert an upward influence on cattle prices. (4) Increased cattle numbers and production in the future must come from increases in technology because of: (a) the limited supply of available land, and (b) the shifts that have taken place in roughage-consuming units are approximately completed. (5) For all cattle there will be a gradual improvement in herd productivity resulting in an increase in the amount of meat marketed annually per animal on farms. (6) Under the influence of shifting cost-price relationships the greatest changes in numbers, percentage-wise, will occur in the North Central, South Central and Western areas. (7) The purchasing-power cycle of cattle greatly affects the cattle industry and appears to operate independently of business booms and depressions, although there is some general relationship in the timing of the up and down swings. (8) Adjustments in the composition of the breeding herd, as the industry shifted from the production of steers toward a cow-calf program, have been of major importance in increasing the productivity of herds. (9) Fluctuations in business activity have very little affect on the cattle number cycle, but do cause some irregular fluctuations in the value of cattle. (10) The price of each grade of cattle tends to follow a rather definite seasonal pattern. (11) The past margin of profit is an important psychological factor affecting changes in the general interest of farmers and financial institutions toward future cattle feeding programs.

229 pages. $2.86. MicA 55-852

FREEZING-POINT DEPRESSIONS IN SANDS, SOILS, AND SYNTHETIC SOIL MATERIALS

(Publication No. 11,845)

Glen H. Cannell, Ph.D.
State College of Washington, 1955

The freezing-point method, using a small thermister as the sensing element, was used to study certain factors believed to affect the freezing-point depression of soil moisture. The factors investigated were particle size, structure, and undercooling temperature. The materials used were homogeneous and consisted of quartz sand, synthetic soil, and IBMA[1] treated Palouse silt loam.

The Palouse silt loam was treated with 0.125% IBMA and formed into aggregates which were separated into groups of various sizes. Freezing-point depression measurements for Palouse silt loam aggregates showed that the freezing-point depression increased with decreasing aggregate size. Alternate freezing and thawing on the various size aggregates showed that the freezing-point depression decreased in the second and third freezings for all the aggregate sizes.

The synthetic soil used was made from quartz sand and illite clay. Some of the synthetic soil was formed into aggregates of 1-2 mm. and treated with various rates of IBMA. Samples containing the highest rate of IBMA were stable in water, whereas, aggregates with smaller rates disintegrated into primary particles when placed in water. The freezing-point depression of the IBMA treated aggregates decreased with decreasing rates. Freezing-point depressions for various sand groups decreased with increased particle size, but the freezing-point depression did not change with alternate freezing and thawing.

To determine the effect of undercooling temperature[2] upon the freezing-point depression the bath temperatures were varied from approximately

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-0.30° C to -2.60° C. Different undercooling temperatures had little effect upon the freezing-point depression for sands or Palouse silt loam aggregates. However, the freezing-point depression for unaggregated synthetic soil was increased with increasing undercooling temperatures.

For freezing-point data to have practical meaning, for the present, correlation of measurements with some standard is required. The pressure membrane data was used as a standard for comparing freezing-point data for synthetic unaggregated soil. A correction was made to reconcile freezing-point depression measurements on synthetic soil with pressure membrane measurements. It is concluded that the Schofield equation by itself is not adequate to convert freezing-point depressions for salt-free systems to moisture tensions as obtained by the pressure membrane or porous plate technique. For synthetic soil two types of corrections are involved, the first is for ice formed in the measuring process and depends upon the undercooling temperature. The second type of correction is of unknown cause but appears to be needed with soil materials. This correction in the case of the synthetic soil is a linear function of the freezing-point depression.

63 pages. $1.00. MicA 55-853

[1]The copolymer of isobutylene and the half ammonium salt-half amide of maleic acid.

[2]The undercooling temperature is defined as the absolute difference between the supercooling temperature (normally the bath temperature) and the freezing-point depression.

THE POSSIBLE EFFECTS OF FREER TRADE ON THE UNITED STATES SOYBEAN PRODUCER

(Publication No. 11,665)

Koppa Venkataramaniah SriRam, Ph.D.
Purdue University, 1955

Major Professor: John W. Hicks

The purpose of this study was to discover and appraise the possible effects of freer trade on the United States soybean producer. The term "freer trade" is seldom used in economic literature. The classical concepts of protection and free trade are hypothetical. At present there are no countries which follow any one of these policies exclusively. Freer trade may mean a movement in many directions. In this study a definition of freer trade was taken to mean a movement towards the following goals:

1. The abandonment of all forms of quantitative restrictions like exchange control, import licenses, etc.,
2. Doing away with all prohibitive as well as retaliatory tariffs,
3. The formulation of a tariff policy consistent with international as well as national welfare. This would mean the retention of tariffs only if they lead to increased national social welfare, without causing serious international consequences.

The theoretical impact of freer trade upon a given commodity was analyzed. From these basic considerations, hypotheses were developed. The present price, production, consumption and trade in soybeans and substitutes were analyzed from the empirical data available. With the help of a single equation model the elasticity of demand for soybeans in the United States for the years 1946 to 1953 was estimated at -.93. The factors affecting the prices of soybeans were analyzed. Finally the following conclusions were drawn with the help of the hypotheses and the empirical data.

1. Freer trade will result in a fall in the prices of soybeans and substitutes in the importing countries leading to their increased consumption and decline in domestic production.
2. The agents of production will move from industries of lower productivity to those of a higher marginal product.
3. The total volume of both exports and imports will increase.
4. The greatest volume of soybean imports are likely to come about in Western Europe because of a large potential need for protein and fat.
5. The United States soybeans will face increased competition from Manchurian soybeans; African peanuts, palm kernals and palm oil; copra and coconut oil originating from Indonesia, Malaya and Philippines; olive oil, butter and marine animal fats of domestic origin.
6. Imports into Western Europe from Asian countries are not likely to increase much because of the relatively inelastic supply of fats derived from perennial plants and also due to the possibility of increasing domestic needs.
7. Imports of soybeans from China-Manchuria may amount to about 20 to 25 million bushels on an annual average. There seems to be a relatively inelastic soybean supply and there is a relatively inelastic demand in the domestic market.
8. African production and exports of peanuts and palm kernals may increase slightly.
9. The demand for soybean meal is likely to be stronger in Western Europe than for soybean oil because meal imports from other countries are meagre.
10. The prices of soybeans as well as of other export products will rise leading to a decline in their domestic consumption and an increase in their production in the United States.

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11. The prices of coconut, palm and other imported oils will fall resulting in an increase in their consumption in the United States and to an increase in their production in foreign countries.

12. The total volume of fats and oilseeds, exported as well as imported, will increase in the United States.

13. The domestic demand for soybean meal will remain strong in the United States because of increasing need for high-protein feeds. Consumption of soybean oil may fall slightly. Since the meal constitutes two-thirds of the price of soybeans, higher prices may be expected for soybeans in the United States market.

14. The United States supply and demand for soybeans are relatively elastic. Therefore, freer trade will lead to an increase in production, trade and income.

15. The larger the market for soybeans, the greater the elasticity of demand, and therefore, the greater the production and exports of United States soybeans.

16. Supplying for larger markets will lead to increased specialization, increased real incomes and therefore to a higher standard of living.

17. Rising incomes and higher standards of living will increase the demand for both protein and fat. It is common experience that the income elasticity for meat and fat is higher than for carbohydrates. In that case higher incomes will lead to increased demand for all oil meals and fats all over the world.

18. Freer trade will not only bring higher incomes to the United States soybean producers who contribute a major supply of protein and fat supply, but also to the entire world.

19. Freer trade by lowering the price levels will lead to lower cost-structures and to higher real incomes which in turn will result in higher standards of living for all the nations.

269 pages. $3.36. MicA 55-854

ZINC STATUS OF SOME ILLINOIS SOILS

(Publication No. 11,548)

Thomas Curtis Tucker, Ph.D.
University of Illinois, 1955

A study was made of an Aspergillus niger method for nutrient elements in soils, and several factors which influenced the bioassay values were investigated. A standard procedure for the bioassay of soils for zinc was adopted and used to obtain values for approximately 100 representative Illinois soils. In general, older soils and sandy soils contained less zinc than less-weathered soils. Bioassay values for zinc ranged from approximately 4 to 30 ppm. in Illinois soils. The lowest values were at least twice as high as bioassay values for soils known to be zinc deficient.

Effect of soil: solution ratio, time of contact, and similar factors affecting the extraction of zinc from soils was investigated. The dithizone method was adapted to the determination of soil zinc in several different extracting reagents, and comparisons of the zinc removed by these different reagents and by the bioassay method were made for 14 Illinois soils. The reagents compared were: 0.1N H Cl, EDTA, the Shaw and Dean dithizone reagent, 2.5% H Ac, and neutral N NH_4Ac. All methods were significantly correlated with each other. Total zinc determinations were made on some Illinois and Florida soils.

Preliminary field and greenhouse investigations were conducted in an effort to measure crop response to zinc fertilization. The zinc treatment was reflected in higher zinc concentrations in the plants and soil zinc values but yield responses were not obtained.

122 pages. $1.53. MicA 55-855

AGRICULTURE, ANIMAL CULTURE

CHANGES IN GROWTH HORMONE CONCENTRATION IN SWINE PITUITARIES WITH AGE

(Publication No. 11,485)

Bryan Baker, Jr., Ph.D.
University of Illinois, 1955

Growth is the basis of the animal producer's enterprise and, therefore, is a most important factor. A better understanding of the nature of this very complex phenomenon will provide a basis for a more intelligent approach to genetic selection and feeding.

It is now well known that the growth hormone of the anterior pituitary directly, or through an intermediate, controls somatic growth of mammals. Because there is little experimental evidence available concerning the changes in growth hormone concentration in the pituitary and the accompanying physical and chemical changes in the animal body, this study was undertaken.

Anterior pituitary glands from 65 female Hampshire and Duroc hogs were assayed for growth hormone using two criteria: (1) increase in width of the proximal epiphysis of the tibia and (2) weight gains of immature hypophysectomized female rats. Pituitary glands were collected from animals belonging to the following categories: fetal, immature, mature, and pregnant. Each of these was further subdivided into four to six subgroups and included a range of weights from fetal to 600 pounds. Chemical analyses and long bone measurements were made on all experimental animals included in the immature and mature phases.

Blood samples from all animals, except fetuses, were analyzed for inorganic phosphate.

Determination of total dry matter, ether extract, nitrogen, and bone ash of the bodies of non-pregnant animals showed an increase in the actual amounts of these constituents throughout the age span (1-1400 days of age) covered in this study. Dry matter, ether extract, protein, and bone ash increased at a rapid rate until the animals reached an age of about 300 days and thereafter continued to increase at a slower rate.

The femur and humerus showed a rapid increase in length during the phase of rapid body growth; after growth slowed, these bones continued to increase significantly in length up to the age of 1400 days.

There were no significant differences between the levels of inorganic phosphate in the blood of non-pregnant and pregnant animals. There was an apparent trend for this constituent of the blood to decrease with age.

The weight of the anterior pituitary increased rapidly until the age of 225 days, after which, the rate of increase slowed but continued rather constantly. The ratio of anterior pituitary weight to body weight decreased rapidly until the age of 225-300 days when the ratio became constant for the remainder of the ages studied.

Growth hormone potency of a given quantity of pituitary tissue (unit potency) was significantly lower in animals less than 20 days of age than it was in older animals. The total hormone potency of the pituitary (unit potency times pituitary weight) was low in fetal glands and increased rapidly throughout life of the animal. The available circulating hormone (total potency divided by body weight) was high in the young animals and decreased abruptly to the age of 300 days, and then plateaued, remaining constant throughout the older ages. No differences in pituitary potency could be ascribed to breed or reproductive state.

CONCLUSIONS

The results of these experiments permit the following conclusions:

1. The continued increase in bone length and in deposition of protein in animals as old as 1400 days of age indicated that growth stasis had not occurred in swine of that age.

2. Pituitaries from fetal and day-old animals contained significantly less growth hormone per unit of hypophyseal tissue than did those of older animals. The unit potency of pituitaries of animals from 20 to 1300 days of age remained constant.

3. The amount of growth hormone available per unit of the animals' body weights decreased until the animals reached 300 days of age and became constant thereafter. The period during which the ratio of growth hormone to body weight was high coincided with the periods of most rapid lengthening of the bones and nitrogen deposition. After this ratio became low and remained constant, only slow growth occurred. These relations may satisfactorily account for the great decrease in the rate of bone growth and nitrogen deposition as growth deceleration occurs.

77 pages. $1.00. MicA 55-856

RESPONSES OF CHICKEN OVARIES TO AVIAN AND MAMMALIAN GONADOTROPHINS

(Publication No. 11,496)

Bhupendra Chandra Das, Ph.D.
University of Illinois, 1955

Gonadal function is controlled by the hypophyseal hormones in both birds and mammals. It has also been well established that avian gonads respond to mammalian gonadotrophic hormones and that mammalian gonads respond to avian gonadotrophic hormones at any age. However, to this date, gametogenesis in immature chickens, until maturity, was considered unattainable.

The present study was, therefore, designed to investigate the essential conditions for precocious development, using crude pituitary powder (chicken) and mammalian gonadotrophic hormones at different age levels and with different operative and dosage treatments. Nine experiments were conducted besides a few preliminary studies to this end. Two breeds of chickens (Gallus domesticus), Rhode Island Red and White Leghorn, were used in these experiments. Age ranged from 10 to 131 days of age, and duration of treatments lasted for 10, 20, 30 and 60 day periods. Both hypophysectomized and normal intact birds of different stages of maturity were used according to the nature and demand of an experiment. The dosages of chicken crude pituitary ranged from 3 mg. to 16 mg. per bird per day and of mammalian gonadotrophic hormones from .25 Armour Unit to 1.5 Armour Units per bird per day. Crude pituitaries were collected from an unknown mixture of male and female chicken heads (broilers).

Data from these experiments indicated that the exogenous chicken crude pituitary powder was able to induce follicle formation in immature and mature females irrespective of hypophysectomy. Exogenous mammalian gonadotrophic hormones could not induce follicle formation either in immature or mature hypophysectomized females thereby indicating that there was a qualitative difference between mammalian gonadotrophic hormones and chicken crude pituitary powder.

Summary and Conclusions

1. Administration of exogenous mammalian gonadotrophic hormones induced accelerated growth of reproductive organs in chickens at any age but did not induce follicle formation in immature or hypophysectomized mature females. However, follicle formation was induced by administration of exogenous mammalian gonadotrophic hormones when the intact birds were beginning to reach sexual maturity.

2. Exogenous chicken pituitary powder induced follicle formation in immature and mature females irrespective of hypophysectomy. Follicle formation was observed in hypophysectomized females as early as 45 days of age following 20 days of treatment.

3. At high dosage levels only did chicken pituitary powder induce follicle formation, presumably

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indicating that the immature female chicken ovary is not refractory to gonadotrophic hormone stimulation, but remains immature because endogenous hormones secreted are not adequate either qualitatively or quantitatively until shortly before sexual maturity is reached.

4. Area measurements of medullary and cortical components of the ovary indicated that in the absence of birds' own pituitaries, exogenous mammalian gonadotrophic hormones could not induce increment in medullary or cortical areas of ovaries of hypophysectomized birds. In contrast, chicken crude pituitary powder did maintain both medullary and cortical areas of hypophysectomized birds' ovaries as compared to intact normal birds.

5. There seemed to be a qualitative difference between mammalian gonadotrophic hormones and chicken pituitary powder, but the nature of this difference remains to be answered.

6. The present investigation did not determine whether chicken pituitary secretes a third hormone or whether luteinizing hormone in the chicken pituitary has a function differing from mammalian luteinizing hormone because the crude chicken pituitary powder used in this investigation was an unknown mixture of both male and female chickens (broilers).

82 pages. $1.03. MicA 55-857

AGE TRENDS IN GONADOTROPHIC AND THYROTROPHIC HORMONES IN SWINE

(Publication No. 11,510)

Richard Hollandbeck, Ph.D.
University of Illinois, 1955

Since the original demonstrations, some 25 years ago, of the interrelation between the hypophysis and its target glands, many attempts have been made to determine how the hormone content of the pituitary gland varies with age, sex, reproductive stage and species. The reason for this interest lies in the obvious connection between the hypophysis and its effect on fertility (gonadotrophic and thyrotrophic hormone potency) and on growth (somatotrophic and thyrotrophic potency). Because of the variety of assay animals used, the lack of standardization of assay techniques between studies and the haphazard sampling of the donor animals, the results obtained and conclusions reached are very diverse and difficult to interpret.

Because of these difficulties the actual relationship between age and gonadotrophic and thyrotrophic potency of pituitaries and such important events as puberty and sexual maturity differs greatly from the generally accepted interpretation commonly presented in textbooks dealing with this subject. This is probably due to the temptation to explain biological phenomena on a "common sense" basis in the absence of experimental data which, as will be shown in the present thesis, bears no resemblance to observed facts.

The gonadotrophic hormone and thyrotrophic hormone content of the pituitaries of 26 Hampshire and 20 Duroc females, varying in age from 1 to 1330 days, including cycling and pregnant animals, were assayed by the male chick technique. The donor animals were sampled during postnatal growth and during pregnancy. The results were correlated with age and body weight.

There is a highly significant positive correlation between the total pituitary potencies of the gonadotrophic and thyrotrophic hormones.

There is no significant difference between breed means of open sows.

The unit potency of gonadotrophic and thyrotropic hormone potencies decrease linearly with increasing age.

The amount of available hormone per unit of body weight is very high at birth, decreases rapidly to about 225 days of age and remains constant through 1330 days of age. The onset of puberty coincides with the lowest titer of available hormone.

The theory is advanced that, starting at birth, there is a high titer of FSH accounting for the high gonadotrophic hormone titer at that age. As age increases there is a gradual decline in FSH coupled with a rising titer of LH. The LH synergizes with the FSH to account for the increase in number and the maximum size attained by prepuberal follicles. Puberty is reached and ovulations occur when the optimal ratio between the two hormones of the gonadotrophic complex is obtained.

The amount of available thyrotrophic hormone is apparently high at birth, decreases rapidly to about 260 days of age and remains constant through 1330 days of age.

The unit potency breed means of pregnant sows differed significantly.

The stage of pregnancy, litter size and sex ratio of the litters failed to show a significant effect on the total gonadotrophic potency or on the total thyrotropic potency of the dam's pituitary.

63 pages. $1.00. MicA 55-858

PROTEIN STUDIES WITH SWINE

(Publication No. 11,516)

James William Lassiter, Ph.D.
University of Illinois, 1955

The effect of protein level on pigs was studied by growth, self-selection and nitrogen retention. The precision of 3-, 5- and 7-day collection periods in nitrogen retention also was tested.

In drylot a protein supplement consisting of soybean oil meal, meat and bone scrap, menhaden fish meal and condensed menhaden fish solubles, fortified with minerals, vitamins and an antibiotic, was used with ground yellow corn to test protein levels of 10, 12, 14 and 16 percent from weaning to 200 pounds on 40 pigs group fed ad libitum. From weaning to 100 pounds the gains were significantly slower at the 10 percent protein level than at 12, 14 or 16 percent. Twelve percent produced significantly slower gains

than 16 percent but not 14 percent. From weaning to 200 pounds the gains at the 10 percent level were significantly slower than at 12, 14 or 16 percent.

On pasture a protein supplement of soybean oil meal, meat and bone scrap and menhaden fish meal was used with ground yellow corn to test levels of 8, 10, 12 and 14 percent on 40 pigs. Covariance analysis of the gains showed that the gains from weaning to 100 pounds were linearly related to protein levels. For the entire test the results suggested that the requirement may be between 12 and 14 percent.

Using the same two protein supplements with ground or shelled yellow corn, free choice feeding was conducted with 18 pigs in drylot and 14 pigs on pasture. In drylot, from the beginning to 100 pounds, the levels of protein selected were 13.7 percent for the pigs on ground corn and 15.3 percent for those on shelled corn. From 100 to 200 pounds these levels dropped to 10.9 and 12.7 percent, respectively. On pasture, from the beginning of the test to 100 pounds, the average protein level selected by either lot was 10.8 percent. From 100 to 200 pounds, the pigs on ground corn selected an average of 10.0 percent protein, those on shelled corn 9.9 percent.

Nitrogen balance studies were made on 32 pigs, weighing approximately 50 or 150 pounds, fed protein levels of 10, 14, 18 or 22 percent. The same corn and protein supplement were used as in drylot. With the small pigs nitrogen retention increased until almost 18 percent protein. With the large pigs, there is some suggestion that protein levels differ but this is not statistically significant. The precision of collection periods of 3-, 5- and 7-day lengths also were tested with these same pigs. The 3-day collection period appeared to be practically as precise as the longer collection periods.

It was concluded that minimum protein allowances for growing swine are influenced by many factors and are not fixed quantities. Thus recommendations should be stated as averages, or as ranges, rather than as precise figures. Considering this, under the conditions of these experiments, the following conclusions seem justified: In drylot, from weaning to 100 pounds, the minimum protein allowance appears to be 14 to 16 percent and from weaning to 200 pounds it appears to be 12 to 14 percent. On alfalfa pasture the allowance appears to be 12 to 14 percent from weaning to 200 pounds with 14 percent advisable under 100 pounds. Maximum nitrogen retention may be obtained at levels of protein higher than those supporting maximum gains in drylot. With preliminary periods of 10 days a 3-day collection period is practically as precise as longer collection periods for the 50-pound pig and even nearer the same precision with larger pigs. 68 pages. $1.00. MicA 55-859

PLACENTAL TRANSFER OF MANGANESE AND PHOSPHORUS IN SWINE

(Publication No. 11,480)

Herman William Newland, Ph.D.
The University of Florida, 1955

Placental transfer of manganese and phosphorus was studied in 20 first-litter sows which had been maintained on high and low levels of dietary manganese. By the use of radiomanganese and radiophosphorus, these respective elements were traced to the fetal pig at 60, 80, and 110 days of gestation. Radioactive and total analyses were made on total fetuses, and certain fetal and maternal organs. The relation of fetal weight to maternal diet, number of fetuses per litter, position of fetuses in the uterus, and absorption of isotopes was studied. Observations were made on fetal atrophy. One sow from each dietary group was allowed to farrow and observations made on the new-born, and suckling pigs.

Apparently normal pigs were farrowed from the sows receiving six and 100 ppm of manganese in the diet during gestation. The high and low levels of manganese in the maternal diet had no apparent relationship either to fetal weights, or to fetal metabolism of natural or radioactive manganese and phosphorus. However, fetuses from sows on the high manganese diets concentrated significantly more manganese than those sows receiving low manganese diets. Manganese concentration was higher in the livers, hearts, thyroids, and blood, from sows receiving the high manganese diets, while the reverse was found in the case of the ovaries.

Maternal and fetal absorption of radiomanganese was at a slower rate than in the case of radiophosphorus. Radiophosphorus absorption and the concentration of inorganic phosphorus was found to be directly related to the weight of the fetus for a given age, but small fetuses at about one-half to two-thirds gestation, had a higher specific activity than large fetuses of the same age. Small fetuses in the two earlier gestation ages studied, showed a higher uptake of P^{32} per gram of liver than large fetuses of the same age. In general however, variation in fetal weights could not be attributed to differential absorption of the nutrients studied.

Fetal femurs metabolized P^{32} more rapidly than maternal femurs, fetal hearts, and fetal livers, while maternal livers showed more activity than any other maternal or fetal organ.

Radiophosphorus transfer rate increased steadily during the last one-half of pregnancy.

Inorganic phosphorus was found to be transferred to the fetal pig in amounts only slightly above that required for growth. Under the conditions of this experiment, some 60-day fetuses were receiving less phosphorus per day than required for growth. Possible relationships of early fetal death to a suboptimum supply of phosphorus were indicated.

A negative correlation was found between fetal weights and the number of fetuses in the litter. Sixty-day fetuses located in the center of the uterine horns were significantly lighter than those at the apex and

bifurcation, while no such relationship was found in the 80- and 110-day fetuses.

Of the fetuses studied, 4.29 per cent were mummies, some of which absorbed detectable amounts of P^{32}, but showed no relationship to location in the uterus. 118 pages. $1.48. MicA 55-860

ESTROGENIC ACTIVITY IN PLANT MATERIALS

(Publication No. 11,654)

Petrus J. S. Pieterse, Ph.D.
Purdue University, 1955

Major Professor: Dr. F. N. Andrews

The use of estrogens in practical livestock production is a recent development. Estrogenic substances present in natural feeds may be advantageous to animal performance but may well have serious consequences when present in excessive quantities.

Extracts of pasture plants, hays, silages and other feedstuffs commonly used in the rations of domestic animals were assayed for estrogenic activity by oral administration, using the uterine weight of ovariectomized mice as the criterion of estrogenic activity. A total of 84 samples of plant materials were assayed. The entire study involved the use of 1,574 spayed female mice.

Before extraction all plant materials were dehydrated in a plant dryer at 170°F. for 24-48 hours to a moisture content of 6-9 percent. To a 350 gram sample of the dried pulverized material, 1400 cc. of 95 percent ethanol were added and refluxed for 1 hour. After cooling, the alcoholic extract was removed by filtration and the plant residue extracted a second time with 1400 cc. of fresh 95 percent ethanol for 1 hour. The two extracts were combined and concentrated under partial vacuum with gentle heating in a water bath, to approximately 300 cc. This concentrated extract was then thoroughly mixed with 300 grams of the standard laboratory mouse ration. After drying, the final weight of the test sample was adjusted to 350 grams by the addition of the stock ration in order that 1 gram of the test ration represented 1 gram of the original plant material extracted. The stock ration containing the plant extract was fed to spayed female mice twice daily at the rate of 3 grams per animal per day. The feed consumption was measured at each feeding. Twenty-four hours after the last feeding the mice were weighed and sacrificed. The uteri were dissected and immediately weighed on a torsion balance.

The grass samples assayed showed little or no activity. Wheat, oats and rye grass elicited a significant increase in uterine weight, but the potency was estimated as less than 0.5 ug. stilbestrol equivalent per pound of dry matter. Fescue, orchard and brome grass were inactive. Among the leguminous species, estrogenic activity was detected in several samples of ladino clover, red clover, alfalfa and birdsfoot trefoil. A trace response was obtained with sweet clover, but the soybean plant, with the exception of the seed, was inactive. The activity in red clover varied in different samples from less than 0.5 ug. to 9.8 ug. stilbestrol equivalent per pound of dry matter. Ladino clover possessed a relatively low potency, with an activity equal to 0.5 ug. stilbestrol per pound of dry matter for the most potent sample assayed. Samples of soybean oil meal, linseed meal, cottonseed meal and moldy corn were also found to possess estrogenic activity.

The variation in activity of alfalfa samples taken at different stages of maturity from several successive crops was also determined. The activity in samples from the original spring growth has shown a trend which would indicate that a high concentration of estrogen is associated with the reproductive growth of the plant. During the vegetative stage no activity was present but there was sudden increase at the early budding stage. At the budding stage the potency declined again almost to the vegetative stage level. Following the initiation of bloom there was a gradual increase in activity which reached a maximum at full bloom, after which time a slight decrease again occurred. The activity in samples taken at different stages of maturity during the second- and third-growths did not, however, show the same pattern of variation, but remained low throughout the entire life cycle. The only exception was a sun-cured sample in the dough stage of the second-growth. This sample showed a marked increase in activity over all previous samples of that crop. Although samples could not be obtained from all the stages of maturity during the fourth-growth, a gradual increase in activity was, nevertheless, noted beginning with the reproductive growth up to the fourth-bloom stage. From a comparison of the activities between alfalfa samples assayed before the first cutting and samples assayed after the first and second cuttings, it would appear that the potency of alfalfa had diminished after the first cutting. On the other hand, third-cutting alfalfa hay was found to be more potent than second-cutting hay. The effect of climatological conditions and changes in soil composition on the estrogenic activity in plants is not known. These factors could have been responsible, in part at least, for the decline in activity noted after the first cutting in alfalfa pasture samples.

Estrogenic activity was found in all the parts of alfalfa tested, i. e. leaf, stem and inflorescence. The leaves were the most potent while the stems showed the least activity.

An extraordinary high activity was detected in alfalfa silage. Attempts were consequently made to determine the origin of the estrogenic activity. Assays of fresh alfalfa samples collected from the same meadow where the silage was harvested, indicated a remote possibility that the alfalfa had possessed the activity before ensiling. It was observed, however, that alfalfa stored in miniature silos showed a very definite increase in activity. The alfalfa before ensiling had an activity of less than 0.5 ug. stilbestrol equivalent per pound of dry matter as compared with 1.4, 1.1 and 8.0 ug. stilbestrol for

alfalfa ensiled without the addition of a preservative or preserved with ground corn and molasses, respectively. In another experiment, a sample containing a mixture of alfalfa, ladino clover and brome grass was assayed before ensiling but no activity was detected. After 7 months storage in an upright silo, a second sample of the same grass mixture was assayed and found to be active, equivalent in potency to 4.4 ug. stilbestrol per pound of dry matter. It was also observed that an alfalfa silage sample taken from the top unspoiled layers had a potency equivalent to 8.0 ug. stilbestrol as compared with an activity of 14.7 ug. stilbestrol per pound of dry matter for a sample taken close to the bottom of the same silo. The mechanism by which the estrogenic activity of alfalfa is increased is not known at present. Presumptive evidence was presented which would suggest that a more potent estrogen was produced during the fermentation processes.

The estrogenic activity of the isoflavone, genistein, was estimated as 3.75×10^{-6} times that of stilbestrol. Refluxing for 1 hour with 1.5 percent potassium hydroxide increased its potency to 1.6×10^{-5} times that of stilbestrol. The minimal detectable oral dose of the glucoside, genistin, was found to be 6.0 mg. per animal. Its aglucone, genistein could readily be detected at a total dose of 2.5 mg. per animal. It was also noted that lemon flavin, containing the flavone glucoside, quercitrin, could be made estrogenically active by refluxing it with 1.5 percent potassium hydroxide for 1 hour. 209 pages. $2.61. MicA 55-861

STUDIES OF THE NUTRITIVE VALUE OF HIGH-PROTEIN CORN FOR LIVESTOCK

(Publication No. 11,530)

Clarence Verl Ross, Ph.D.
University of Illinois, 1952

The protein quality of Illinois High-Oil and Low-Oil corn was studied in nitrogen balance tests with white rats. Differences were highly significant in favor of the high-oil corn. Rats fed the high-oil corn also made significantly greater growth and produced significantly more hair per unit of surface area.

Fattening lambs were trio fed on an equal feed basis, using corn containing 7.48, 11.05 and 13.24 percent crude protein (fresh basis), respectively. Differences in gains, wool growth and carcasses were not significant as between the 11.05 and 13.24 per cent protein groups, but both of these made significantly greater gains than did the lambs on low-protein corn.

Sixteen pigs weighing 100 pounds each were fed individually ad libitum in a factorially designed experiment with rations composed of corn, minerals and an antibiotic. High-protein corn (13.29 per cent) and medium-high protein corn (10.38 per cent) were compared with and without the addition of B vitamins, and with and without the addition of blood meal. Only blood meal gave a significant response.

Large pigs (150-175 pounds) trio fed on high, medium and low protein corn, on an equal-feed basis for four weeks, showed no significant differences in gain or in feed consumption per unit of gain. High-protein corn did result in significantly faster gains than low-protein corn.

Various types of protein sources were tested as supplements to high-protein corn for growing pigs, with and without the addition of dl-lysine, dl-tryptophan, and dl-methionine in crystalline form.

CONCLUSIONS

Within the limits of the conditions imposed in this study, the following conclusions seem justified:

1. Illinois High-Oil corn has higher biological value for white rats than Illinois Low-Oil corn.
2. High-protein corn has greater nutritive value from the standpoint of body gains and wool growth for fattening lambs than low-protein corn.
3. Corn containing 11.05 per cent crude protein is as efficient as corn containing 13.24 per cent crude protein for fattening lambs and for growing-fattening pigs weighing more than 100 pounds.
4. No significant increase in weight due to adding B vitamins to a high-protein corn and mineral ration for a 100-pound pig can be expected if the pig has adequate B vitamins prior to 100 pounds.
5. For satisfactory growth, a protein supplement must be fed with high-protein corn for weanling pigs. Even pigs weighing as much as 175 pounds will make greater gains in weight when a protein supplement is added to the high-protein corn ration.
6. Growing-fattening pigs will make significantly greater gains on a high-protein corn ration fortified with vitamins and minerals if adequate quantities of dl-lysine, dl-tryptophan, and dl-methionine are added.
7. In the presence of adequate vitamins, minerals, tryptophan, and methionine, the level of dl-lysine required to supplement high- (13.24 per cent) protein corn is 1.0 per cent or lower for 40-pound pigs on a ration containing 14.61 per cent crude protein.

108 pages. $1.35. MicA 55-862

THE REQUIREMENT OF THE CHICK FOR UNIDENTIFIED GROWTH FACTORS WITH SPECIAL REFERENCE TO ASSAY TECHNIQUES

(Publication No. 11,542)

John Marshall Snyder, Ph.D.
University of Illinois, 1955

Basal diet studies. It has been demonstrated that the conventional 18 percent casein, 10 percent gelatin diet is deficient in arginine and that the optimum level of this amino acid in a purified diet is approximately 1.70 percent. Nevertheless when fed purified diets known to be adequate in arginine, chicks continued to respond to crude sources of unidentified factors.

The growth response of chicks to crude sources of unidentified factors (alfalfa, liver and whey)

decreased as the percent protein, contributed by purified soybean protein (Drackett) and amino acids, was increased in increments of 5 percent covering the range from 20 to 35 percent. This was true both for the standard Drackett protein as well as the Drackett protein which had been re-extracted with alcohol. It was concluded therefore that Drackett protein contains an unidentified factor required for chick growth which is not soluble in alcohol.

Assays involving chicks growing at different rates. In an effort to develop a more sensitive assay technique, chicks were fed a basal-type diet for 7 days and then divided into rate of growth categories according to either the ratio of 7-day weight to 1-day weight or the absolute weights of the chicks. The chicks were then subjected to different dietary treatments in order to ascertain if the slow-growing chick would be more responsive to a given supplement than would the fast-growing chick. The data indicated that the chicks which performed poorly on an unsupplemented diet responded relatively better when placed on a supplemented diet than did the chicks which had performed well on an unsupplemented diet. This was more evident in assaying for arginine than for the unidentified factors. There was no evidence that the slow-growing chick was more sensitive to antibiotic supplementation than was the fast-growing chick. In no case was the response made by the slow-growing chick statistically significant over that made by the fast-growing chick.

Effect of antibiotics on the assay for unidentified growth factors. Terramycin and penicillin were equally effective in promoting growth when incorporated into a purified diet. There was no statistically significant interaction between an antibiotic and alfalfa, liver or whey factors.

Relationship between unidentified growth factors. Sun-cured alfalfa meal, powdered defatted liver, dried whey, dried forage grasses and corn distillers solubles were effective in promoting chick growth when added to a purified diet complete in all known factors. The results would suggest that the alfalfa, liver, whey and corn distillers solubles factors are separate and distinct factors which are additive in action.

When tested simultaneously in all possible combinations liver was found to be most effective in promoting chick growth; alfalfa, second; and whey, third.

105 pages. $1.31. MicA 55-863

AN ANALYSIS OF RENTAL ARRANGEMENTS ON FARMS PRODUCING HOGS

(Publication No. 11,671)

Moyle Strayhorn Williams, Ph.D.
Purdue University, 1954

Major Professor: Dr. Lowell S. Hardin

This study deals with changes needed in traditional rental arrangements to facilitate adjustments in farming systems and to promote efficient production. It includes, in addition, suggested ways in which needed changes can be instituted.

The data were obtained by field survey. Schedules were completed on 124 rented units where hogs were being produced in 1951 in the North Central Coastal Plain Area of North Carolina. A selective sample was used.

Two approaches used were: (1) an empirical analysis of farm organization, practices, and leases on farms studied; (2) an analysis of the leases studied based on the theoretical concept of the "model lease," as a standard with which the leases were compared.

The empirical analysis includes a description of the farms and leases. There were 107 share-rent leases and 17 cash-rent leases. The farms were primarily cash crop farms – tobacco, cotton, peanuts, and corn.

The analysis of farm organization and practices indicated the farms studied were above average for the area.

The analysis of the 17 different types of leases was an attempt to determine the effects of selected characteristics on economic efficiency. The findings indicated that leases which included a large number of the selected features were generally associated with efficient farms. The presence of the selected characteristics were important, but no individual characteristic was predominant.

The model lease used in the second approach was developed from economic theory and logic, and from an appraisal of other studies. Separate provisions were included for both cash-rent and share-rent farms. The provisions of the model lease were used as a basis for evaluating and appraising the types of leases actually found on farms. Departures from the model were regarded as undesirable imperfections leading to inefficient resource-use unless some logical overriding explanation was found.

It was found that the actual lease did not include the elements considered necessary in the model. However, the actual leases did coincide with the model to the extent that the addition of livestock and tractor power and machinery was feasible on the farms studied.

The empirical and theoretical analysis did not provide a basis for rejecting the model lease; however, the analysis indicated that certain provisions deemed necessary to the model lease were not required in a lease that would insure efficient production.

A suggested method for sharing inputs was presented, based on the findings in this study.

In addition, representative farms and leases were studied to indicate how the model lease might be applied to situations in the area. These efforts indicated the necessity of other adjustments concomitant with changes in leases, if more efficient production is to result. For example, small size of unit was one of the major obstacles in securing a lease that would encourage efficient production.

Changes in existing leases seem to be needed, if other adjustments leading to more efficient production are to occur. The study includes an appraisal of the possibility of such changes, the probable effects resulting from the introduction of improved leases, and whether they will be accepted.

328 pages. $4.10. MicA 55-864

AGRICULTURE, FORESTRY AND WILD LIFE

SELECTED FACTORS AFFECTING THE SUMMER USE OF PUBLIC CAMPGROUNDS IN FIVE COUNTIES OF NORTHERN MICHIGAN

(Publication No. 11,374)

Arthur Thomas Wilcox, Ph.D.
University of Michigan, 1955

The purpose of this study was to analyze the design of public campgrounds within a restricted area and the habits and objectives of summer vacation campers who use them, determine some of the factors which influence campground use and suggest ways by which public campgrounds may better serve their purposes as recreational facilities.

Public campgrounds are one of the principal intensively developed recreational areas in the public lands of this region, and as such their development and management are matters of major concern to public land administrators.

The area of study was selected because it is a vacation camping area with no large cities, reached only by four principal automobile routes, yet conveniently located with respect to several large urban centers of the Midwest. There are forty-eight established public campgrounds within the five counties of the eastern Upper Peninsula of Michigan. These were carefully studied during the summers of 1952 and 1953 to determine the values which contributed to or detracted from their attractiveness for camping. During the summer of 1953, seven hundred and ninety-two groups of campers were interviewed concerning their camping habits and objectives. The interviewing procedure permitted a representative sample to be taken of five per cent of all campers in campgrounds of the region.

It was found that campgrounds in the area may be divided into two principal types. One is characterized by simple facilities and maintenance, small size and isolation from communities and major highways. The other usually possesses running water, flush toilets and electricity and is located near communities and major highways. Campers show a decided preference for one or the other of these types of areas according to their previous camping experiences and attitudes toward certain features of campground location, development and use.

It was found that those who camp do so during most of the period of their summer vacation but their stay at any one campground is brief. Ninety-three per cent of all camping groups are families who consider camping for the benefit of their children and for economy reasons as important as love of the out-of-doors, the reason most often given for camping. Features most desired in a campground are good scenery, with open water and satisfactory facilities for outdoor living. The activities of campers closely parallel those of all tourists to the area.

It was concluded that campgrounds in this area are generally satisfactory and may best be improved by better use of local scenic attractions, control of vehicular traffic, special attention to maintenance of sanitary facilities and development of minor facilities to satisfy camper needs.

There is a need for long range planning on the part of all agencies concerned with recreation in the area and better interagency cooperation in order to facilitate regional planning for future campground development, protect the region's scenery as a basic resource, and make possible better dissemination of the recreational information.

245 pages. $3.06. MicA 55-865

AGRICULTURE, PLANT CULTURE

CHEMICAL CHANGES ASSOCIATED WITH LOSS OF FLAVOR OF J. H. HALE PEACHES DURING STORAGE

(Publication No. 11,844)

Ahmed Farouk Abdelal, Ph.D.
State College of Washington, 1955

This study was divided into two phases. The first phase dealt with the effect of a prestorage ripening period at 75° F. on the quality of peaches, the effect of storage temperature on the quality of peaches and the combination of these two factors which yields the highest quality after ripening. The effects of the various treatments were evaluated by means of a series of taste evaluations.

Highest quality was attained by those peaches which received a three-day ripening period before storage at 31° F. Peaches which were placed directly in storage after harvest and those which received one day prestorage ripening were definitely inferior in quality. Storage at 31° F. was better than storage at 35° F. and 35° F. was better than 40° F. There was a definite complementary effect of prestorage delay and storage temperature on flavor.

The second phase of this study dealt with the chemical changes which occurred during prestorage ripening, ripening after storage and during storage and breakdown. There was a marked increase in all sugars and soluble solids during the three day ripening period, which was comparable to the increase which occurred during ripening after one week. Very little change occurred during the same period of time in peaches which were placed in cold storage immediately after harvest or held at storage temperature during the final ripening period. The increase in sugars and soluble solids was attributed to hydrolysis of starches and pectins as well as to an apparent increase due to the concentration of solids caused by water loss through transpiration.

Starches decreased rapidly during the three day ripening period and during ripening after one week of storage.

Soluble pectin increased rapidly during the three day ripening period and during ripening after one

week. The pH and titratable acidity varied inversely, the greatest change occurring during the prestorage ripening period and ripening after one week of storage. Softening of peaches increased gradually throughout the storage period. It increased rapidly during the prestorage ripening period and during ripening after storage.

Thus the most rapid change in all chemical constituents measured was during the prestorage ripening period and during ripening after storage.

56 pages. $1.00. MicA 55-866

THE INTERACTION OF SURFACE SOIL, SUBSOIL AND PLANT GROWTH

(Publication No. 11,615)

Anson Rabb Bertrand, Ph.D.
Purdue University, 1955

Major Professor: Dr. H. Kohnke

Results of many experiments reported in the literature point to the fact that plant growth may be adversely affected by subsoil conditions. This study was initiated to investigate the effects of dense, acid and relatively infertile subsoils on plant growth. The effects of plant growth and deep fertilization on certain soil properties were also studied. It was reasoned that mechanical opening, liming, and fertilizing these subsoils would aid plant growth.

No satisfactory method for subsoil fertilization existed; therefore machinery was designed and constructed for this purpose.

The effects of subsoil shattering and subsoil fertilization on plant growth and soil conditions have been studied by field and greenhouse experiments. This study included the measurement of soil aeration at given levels of soil compaction, soil moisture, soil acidity and soil fertility. Particular emphasis was given to a study of the effects of subsoil treatments on corn root growth. It was found that loosening, fertilizing, and liming subsoil resulted in larger and deeper corn root systems and higher crop yields.

Several methods have been used to study corn root growth and distribution. These methods are described and evaluated. A modified soil block washing method for studying root systems is presented.

The effects of different levels of soil moisture, subsoil density, subsoil fertility, and depth on the oxygen status of the subsoil have been studied by three methods. A comparison of these methods is presented.

An attempt has been made to establish critical rates of oxygen diffusion in the soil in which corn was grown. Certain critical oxygen diffusion rates are suggested.

Pot experiments have shown that under the conditions used subsoil compaction to a density of 1.5 grams per c.c. limited corn root distribution.

212 pages. $2.65. MicA 55-867

THE EFFECT OF 2,4-D ON QUALITY AND AGRONOMIC CHARACTERISTICS OF WHEAT

(Publication No. 11,631)

Arvin R. Hilst, Ph.D.
Purdue University, 1955

Major Professor: Dr. F. L. Patterson

A study was initiated in the fall of 1950 to determine the effects of 2,4-D spray applications on the agronomic characteristics of wheat and the quality of the harvested grain. Two separate experiments were designed. In an effort to determine the effects of 2,4-D on the agronomic characteristics of wheat, 3 replications of each of 2 varieties of soft red winter wheat, Vigo and Fairfield, and 1 variety of hard red winter wheat, Pawnee, were sprayed with the amine or the ester formulation of 2,4-D. Seven rates of application were made at each of 5 stages of plant development. The rates of application were as follows: 0, 1/4, 1/2, 3/4, 1, 2, and 8 pounds of 2,4-D per acre. These rates were applied at each of the following stages of development: tillering, jointing, boot, kernel dough, or mature stage.

In an effort to determine the effect of 2,4-D spray applications on the quality of the harvested grain, 2 replications of 2 varieties of soft red winter wheat, Vigo and Fairfield, were sprayed with the amine formulation of 2,4-D. Three rates of application, 1/2, 2, and 8 pounds per acre, were applied at the boot, heading, or kernel dough stages of development.

A morphological study was made of the apical meristem of the wheat plant in an effort to determine the ontogeny of the growing point when the wheat plant was most susceptible to 2,4-D injury.

Special spraying equipment was designed and constructed for maximum accuracy of application and prevention of drift of the 2,4-D solution.

There was very little evidence that recommended rates of application, 1/4 to 3/4 pounds per acre, of 2,4-D influenced the yield of wheat. Rates higher-than-recommended for weed control produced marked yield reductions except when the treatments were made during the mature stage of plant development. Yield reductions were related to the amount of 2,4-D applied.

There was little evidence that recommended rates of application influenced 1000-kernel weight or test weight. High rates of application caused only small reductions in 1000-kernel weight and test weight.

The rate of application or the stage of development when the treatments were made had very little influence on the germination of the harvested grain.

All 2,4-D treatments influenced pearling, lodging, legume survival, and weed control. The high rates of application in each instance produced the greatest effects. The degree of injury was proportional to the amount of 2,4-D applied.

Low rates of 2,4-D application produced only small variations in the percent protein of the harvested grain. The higher-than-recommended rates of application produced large increases in the percent protein, except when the treatments were made during the mature stage of development. However,

the amount of protein synthesized per acre (yield x percent protein) was decreased by these same high rates of application.

There was much evidence that the higher rates of 2,4-D application reduced the commercial quality of the soft red winter wheats, when measured by pearling indices, protein content, mixograph curves, viscosity values, and the cookie baking tests.

A morphological study of the apical meristem indicated that the wheat plant was very susceptible to 2,4-D injury during periods of meristematic differentiation.

An analysis of the components of yield indicated that yield reductions were a result of (a) decrease in the number of kernels per spike, (b) reduction in spike length, (c) reduction in the number of culms, and (d) reduction in kernel weight.

Many abnormal morphological changes resulted from the high rates of 2,4-D application.

257 pages. $3.21. MicA 55-868

STUDIES OF A CHLORITE TYPE MINERAL IN INDIANA SOILS

(Publication No. 11,636)

Murray George Klages, Ph.D.
Purdue University, 1955

Major Professor: Joe L. White

The occurrence and properties of a clay mineral having an interplanar spacing similar to that of vermiculite and chlorite were investigated. The techniques used were x-ray diffraction, electron microscopic examination, differential thermal analysis, base exchange capacity measurements, and chemical analysis. The effect of heat and of various chemicals on its properties was examined.

The mineral was found to occur in the surface of many Indiana soils. Its properties were found to be intermediate between those of vermiculite, montmorillonite, and chlorite.

It was concluded that the mineral is formed during weathering of illite by the replacement of potassium in the interlayer position by aluminum or iron, in the form of exchangeable ions and hydroxides.

112 pages. $1.40. MicA 55-869

THE USE OF IONIZING RADIATIONS IN THE POSSIBLE UTILIZATION OF AN AGROPYRON SOURCE OF BUNT RESISTANCE

(Publication No. 11,847)

Edward Nathan Larter, Ph.D.
State College of Washington, 1955

A program was initiated whereby ionizing irradiations were used in an attempt to transfer genes for resistance to bunt (Tilletia sp.) from a 56-chromosome wheat-Agropyron derivative to a hexaploid wheat. The transfer and ultimate stabilization of desired Agropyron characters in a commercial wheat afford certain problems. Such difficulties have arisen from the fact that in hybrids produced from these two genera, there often occurred a complete lack of association between certain of the Agropyron and T. vulgare chromosomes. As a result, natural recombination between the two chromosomal complexes was seriously restricted. Such was the case in the present study whereby the Agropyron bunt resistance was conditioned by one or more of seven chromosomes which were asynaptic with those of T. vulgare.

Various sources of ionizing radiations including x-rays, thermal neutrons, and radiosulfur and radiophosphorus, were administered to hybrid seeds in an attempt to induce chromosome breakage and subsequent translocation. The relative efficiencies with which these sources induced such translocations were measured by scoring the frequency of multivalent formation as observed at metaphase I of X_1 (first treated generation) hybrid plants. Efficiency from the point of view of practicability was also taken into account by scoring the number of treated plants that survived to maturity as well as their percentage seed set. Since chimeras were prevalent among treated plants, all X_1 spikes were harvested separately. X_2 seed was artificially inoculated with bunt races T-13 and T-16 and was fall sown at Pullman, Washington and Pendleton, Oregon. At microsporogenesis, X_2 plants were scored as to their chromosome number and after heading were classified with respect to disease reaction.

The linear regressions of survival, interchanges per cell, and fertility on dose of x-rays each exhibited a negative trend. The lowest dose of x-ray used in the present study (10,000 r-units) therefore, appeared most efficient. That no relationship existed between chromosomal interchange and X_1 plant survival was suggested from the results obtained from the thermal neutron-treated population. Although the occurrence of chromosomal interchanges increased with neutron dosage increments, the level of plant survival was affected very little. In comparison with the results obtained with thermal neutrons and x-rays, both P^{32} and S^{35} were relatively ineffective in inducing chromosomal translocations in the material under study. Both survival and fertility of X_1 plants were decreased greatly with increased dosages of the two radioisotopes.

Although chromosome numbers of disease-free X_2 plants ranged from 2n=42 to 2n=56, their distribution was sharply skewed in the direction of the higher chromosome classes. It is noteworthy that despite selective elimination of gametes with the higher chromosome numbers, genetic stability as well as resistance to bunt was still retained at the lower chromosome levels. No correlation existed between X_2 chromosome numbers and such characters as spike-type and fertility. The occurrence of bunt-free X_2 plants with chromosome numbers as low as 42, 43 and 44 was suggestive that few Agropyron chromosomes conditioned resistance to bunt. In view of this possibility, a monosomic breeding technique

was started in an attempt to obtain hexaploid progeny containing the Agropyron resistance. In the summer of 1954, disease-free 43-chromosome X_2 plants were crossed with monosomic plants of T. vulgare var. Chinese Spring. Progenies from these crosses are now under study and will be analysed cytologically in conjunction with their reaction to bunt.

Although disease-free, near hexaploid (2n=42) plants were obtained in the X_2 and BC_2 populations, data from more advanced segregating generations are required before an overall appraisal of results of the present study is possible.

60 pages. $1.00. MicA 55-870

FACTORS ASSOCIATED WITH THE RESPIRATION OF RIPENING TOMATO FRUITS

(Publication No. 11,520)

Edward William Melvin, Ph.D.
University of Illinois, 1955

The respiratory behavior of ripening tomato fruits was studied in an endeavor to determine the relationship of factors affecting the rate of respiration to changes in content of carotenoid pigments, sugars, organic acids and Vitamin C. Although the respiratory climacteric occurred at an average of about two days after initial carotenoid formation it varied from one to five days among individual fruits. Both rate of respiration and height of the climacteric were found to be inversely related to size of fruit and the greatest differences in respiratory rate between individual samples occurred at the time of the climacteric.

Fruits that were exposed to sunlight during development had a consistently higher level of respiration and a slightly greater content of sugars than fruits that were shaded.

Bruised fruits were found to respire at a significantly higher rate and have a more pronounced climacteric than unbruised fruits of similar size. The increased respiration of the bruised fruits was accompanied by an increase in total sugars but a marked depletion in content of organic acids.

This relationship of respiration to sugar content was not found when Double-Rich and Stokesdale fruits were compared. Samples of the former variety although respiring more rapidly than the latter, were found to be significantly lower in sugars and total acidity although significantly higher in ascorbic acid (Vitamin C).

Changes in the content of carotenoid pigments, sugars, organic acids and ascorbic acid did not parallel the respiratory curve of ripening tomato fruits.

47 pages. $1.00. MicA 55-871

CHARACTERISTICS OF SOME SANDHILL SOILS AND THEIR INFLUENCE ON THE GROWTH AND RESPONSE OF MEADOW VEGETATION TO FERTILIZATION

(Publication No. 11,229)

John Samuel Russell, Ph.D.
The University of Nebraska, 1955

Adviser: Harold F. Rhoades

A series of experiments dealing with the effects of nitrogen and phosphorus fertilization on the hay yields of wet meadows in the Nebraska Sandhills was initiated in 1948. Differences in fertilizer response were obtained among the meadows studied. Some of these differences could be attributed to water table levels and the nature of the vegetation. Other differences could not be explained. The present study was undertaken to determine the factors responsible for variation in fertilizer response of the wet meadows in the Sandhills.

Sixteen sites were selected from which hay yields in 1951, 1952 and 1953 were available. Soil samples from these sites and from representative soil profiles were collected in 1952 for the purpose of chemical and physical analyses. Vegetation analyses using the point quadrat method were made to determine the botanical composition. Analyses were made of the nitrogen and phosphorus contents of the vegetation. Changes in the yield and chemical composition of the vegetation throughout the season were studied at two additional sites. The forage of ten component species was sampled at these two sites and differences in chemical composition due to applied fertilizer were studied with the aid of P_{32}.

Representative profiles of Dune sand, Valentine, Elsmere, Loup and Gannett series were sampled to study the characteristics of the major soils present in the Sandhills. These soils form a catena which is an excellent example of a hydrosequence.

Most of the experimental meadows were situated on Loup soils. Correlation of soil properties and the response of the vegetation to nitrogen and phosphorus fertilizer were complicated by seasonal differences. Nitrification rates of most surface soils determined in the laboratory were relatively high. Rate of mineralization of organic nitrogen in the field, however, appeared to be low judged by the response of grasses to nitrogen fertilizer. Aeration and soil temperature during a portion of the growing season are not favorable to nitrification and it appears likely that grass vegetation influences nitrification unfavorably. Available phosphorus by chemical tests was low to very low in all soils. Lack of response to phosphorus fertilizer on some of these soils where chemical tests indicated a deficiency appeared to be associated with the presence of large amounts of phosphorus in the organic form. Additional research particularly on the changes in the forms of nitrogen and phosphorus in the soil is necessary before adequate criteria can be developed for predicting response to fertilizer on the wet meadows.

Changes in the chemical composition of mixed vegetation due to fertilizer application were associated with variations in the botanical composition of meadows and changes in the chemical composition of individual species. The percentages of nitrogen and phosphorus in the vegetation decreased throughout the season irrespective of fertilizer treatment but calcium and magnesium percentages showed little change. Studies of phosphorus fertilizer using P_{32} showed that clovers utilized fertilizer phosphorus much more than grasses. Accordingly growth of clovers in meadows was markedly increased with phosphorus fertilizer. Phosphorus utilization by clovers was unchanged with an addition of nitrogen fertilizer but by grasses it was increased. Kentucky bluegrass utilized more fertilizer phosphorus than the other grasses studied. The nitrogen percentage of ten component species was little affected by phosphorus fertilizer or nitrogen and phosphorus fertilizers combined but phosphorus percentage was markedly increased by those fertilizers.

173 pages. $2.16. MicA 55-872

THE RESPONSE OF SOYBEANS TO SELECTED PRE-EMERGENCE AND POST-EMERGENCE HERBICIDES

(Publication No. 11,540)

Roy Jefferson Smith, Jr., Ph.D.
University of Illinois, 1955

Chemical weed control has not progressed as rapidly in soybeans as in many other crops. The chief reason is that soybeans are injured by most of the present day herbicides. At present the most common way of controlling weeds in soybeans is by cultural methods.

The objectives of this study were: (1) to further investigate the possibilities of using pre-emergence herbicides for controlling weeds in soybeans, (2) to determine if certain post-emergence herbicides could be used effectively in soybeans, (3) to investigate the influence of two of the most promising pre-emergence herbicides, isopropyl N-(3-chlorophenyl) carbamate and dinitro-o-sec. butyl phenol, on the germination and on root and shoot growth of soybeans, and (4) to gain knowledge on the persistence of isopropyl-N-(3-chlorophenyl) carbamate in a soil.

Material and Methods

Field experiments were conducted on the Agronomy South Farm at Urbana, Illinois, during the growing seasons of 1953 and 1954.

Field studies were conducted to study: (1) the effect of five pre-emergence herbicides on soybeans (variety Hawkeye) – they were: dinitro-o-sec. butyl phenol (DNBP), isopropyl-N-(3-chlorophenyl) carbamate (CIPC), sodium pentachlorophenate (sodium PCP), N-1-naphthyl-phthalamic acid (NP), and the amine salt of 2,4-dichlorophenoxyacetic acid, (2) the effect of Lion Herbicidal oil No. 1(L.H.O.-1) applied post-emergently as a directional spray to soybeans of different growth stages, (3) the influence of soybean stand on the yield, (4) the effect of DNBP and CIPC on soybeans when they were planted one-half, one and two inches deep, and when simulated rainfall followed the herbicidal treatments, and (5) the effect of DNBP and CIPC on soybeans which were planted on level, concave, and convex shaped seed beds, when simulated rainfall followed the herbicidal applications.

Greenhouse and laboratory studies ran in conjunction with the field test were, (1) the effect of DNBP and CIPC on the germination and subsequent root elongation of cotton and soybeans, (2) the effect of DNBP and CIPC on the growth of soybean seedlings, and (3) the effect of temperature on the persistence of CIPC in a silty loam soil.

Results

Pre-emergence studies. The effectiveness of the pre-emergence herbicides was highly dependent on the weather conditions that followed the herbicidal applications. CIPC gave good weed control with little injury to the soybeans. DNBP caused some early injury, manifested by leaf and stem burning and stand reductions but no reductions in yield. NP, sodium PCP and 2,4-D gave varied results.

Post-emergence oil. L.H.O.-1 caused some immediate injury to soybeans but the beans recovered rapidly.

Effect of stand on yield. Yield reductions did not occur until stands were reduced to approximately one-half of the original stand.

Effect of depth of planting and seedbed shape. DNBP caused more injury to soybeans planted at different depths than did CIPC. The contour of the seedbed had no effect on the performance of DNBP or CIPC in these tests.

Effect of DNBP and CIPC on germination and root elongation. DNBP was more toxic than CIPC to the germination and root elongation of cotton and soybeans.

Effect of DNBP and CIPC on the growth of soybean seedlings. CIPC was more injurious than DNBP to the growth of soybean seedlings. DNBP gave similar effects on all growth stages. CIPC was more toxic to the younger stages than to the older stages.

Persistence of CIPC in a soil. At temperatures of 85°F and above most of the CIPC was lost from the soil after an incubation period of four weeks.

Discussion and Conclusions

1. The results obtained with pre-emergence applications were highly dependent on the weather conditions that followed the pre-emergence application. CIPC and DNBP gave the best results. These tests did not reveal a pre-emergence herbicide which was completely satisfactory for weed control in soybeans.

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2. The use of a post-emergence herbicidal oil appeared promising but further investigations are needed.

3. If herbicides are applied to soybeans either as pre- or post-emergence applications, the stand may be reduced considerably without corresponding yield reductions.

4. DNBP was more toxic than CIPC to the germination of soybeans, but CIPC was more severely toxic than DNBP to soybeans which were in the seedling stage.

5. The persistence of CIPC in the soil was highly dependent on the temperature.

124 pages. $1.55. MicA 55-873

ANATOMY

THE ROLE OF THE GOLGI ELEMENT IN THE DIFFERENTIATION OF CELLS WITHIN THE PRIMARY AND SECONDARY ISLETS OF THE EMBRYONIC CHICKEN PANCREAS

(Publication No. 11,590)

Raymond Otto Heckerman, Ph.D.
University of Pittsburgh, 1955

Embryos of the domestic chicken, Galus domesticus, were fixed in DaFano's cobalt nitrate-formol solution at 24-hour intervals to form a series beginning at 72 hours of incubation and terminating with hatching for a study of pancreatic development.

To demonstrate the Golgi element of constituent cells in islet tissue the silver impregnation method of DaFano was used. As a counterstain to demonstrate concurrently the relationship between the Golgi element and secretory granules, Mallory's connective tissue staining method was used. A combination of these cytological techniques, as applied to embryonic chicken pancreas, was used to determine the origin, time of appearance, and cell lineage between the different types in both Primary and Secondary Islets.

Primary Islet cells are found within the dorsal diverticulum of the embryonic pancreas as early as the third day of incubation. These cells are classified into three morphologically different groups, which are referred to as cell types I, II, and III. The mesenchyme of the dorsal mesentery surrounding the primordial pancreas contains the "red cells of the mesenchyme," which are destined to differentiate into the cells of type III. Primary Islets isolated within the mesenchyme are first observed at the end of the fourth day. At this time type I cells are found to possess peripheral vacuoles. This vacuolization eventually leads to complete disappearance of type I cells. Primary Islets are observed within the pancreas at least until the seventeenth day.

Secondary Islets containing all of their morphologically different cell types, namely, type A cells, "transition" cells, and type B cells, are first seen at the end of 12 days of incubation. The pancreatic connective tissue contains the "red cells of the embryonic connective tissue," which are destined to differentiate into type A cells. Such connective tissue cells are first noted at six days. Type A and "transition" cells appear initially at 10 days, whereas type B cells are first seen at 12 days. Vacuolization and degeneration of type B cells also occurs, but is not noted until the fifteenth day.

The origin and cell lineage of both Primary and Secondary Islet cells in the embryonic pancreas of the chicken is based on observations of the morphology of their Golgi elements, the staining reactions of their Golgi interna, and the coloration of the cytoplasm. A study of the variations for these characteristics as seen typically in each cell type indicates a relationship or lineage among the cells of both Primary and Secondary Islets, respectively. The cells of the Primary Islets originate with the "red cells of the mesenchyme" and are followed in sequence by cell types III, II, and I. Secondary Islet cells, on the other hand, originate with the "red cells of the embryonic connective tissue," and are followed by type A cells, "transition" cells, and type B cells, respectively.

Many Primary Islets containing degenerating type I cells possess a peripheral layer of cells (epithelial type II cells) which are closely related to cells of type II. Such islet structures suggest the formation of pancreatic ducts. They are first noted at the fourth day of incubation and at subsequent stages during the time Primary Islets are seen. Secondary Islets also are noted containing degenerating type B cells and surrounded by a peripheral layer of epithelioid cells. Such epithelioid cells, called the epithelial "transition" cells, are closely related to the typical "transition" cells of Secondary Islets. This also suggests a means of duct formation in the embryonic chicken pancreas. The initial appearance of these Secondary Islet structures is at 15 days.

92 pages. $1.15. MicA 55-874

OJIBWA SOCIALIZATION: SOME ASPECTS OF PARENT-CHILD INTERACTION IN A CHANGING CULTURE

(Publication No. 11,554)

Stephen Taylor Boggs, Ph.D.
Washington University, 1954

Chairman: Preston Holder

This study explores the relations in certain measurable aspects between the culture of a people, parent-child relations, and individual personalities. By means of comparing differentially acculturated contemporary Ojibwa communities, and samples of their members and families, with one another and with accounts of historic Ojibwa; changes in these variables over subsequent generations are inferred. Since the changes appear to coincide, it is concluded that the variables may be related.

Prior study of three communities by Hallowell and others, using the Rorschach and other projective personality tests, indicated that an "introverted" type of underlying personality structure persisted despite extreme acculturation. One year's field work, financed by the Social Science Research Council, was undertaken in two of these communities in an attempt to expand these findings. Participant observations in nine families provided descriptions of the interactional situations involving 32 infants and children with their parents, as well as data on child-care techniques and other family culture patterns.

Evidence of the relative acculturation of the communities and families is presented. Interactional situations are analyzed in terms of the relative frequency and "success" for each child of certain interactional behavior patterns defined by the observer. The methods of interpretation are developed in the study and the results are reported as probability estimates. For purposes of the study the relative frequency of these interaction patterns is equated to overt personality functioning, and their relative success is used as an indicator of parent-child relations. The latter is also analyzed through child-care techniques, which are described for a somewhat larger sample.

A major finding is that more children of the less-acculturated families typically interact in the ways which are described for historic Ojibwa adults, leading to the conclusion that major changes in personality functioning have occurred. With the greatest amount of acculturation children overtly manifest more passive negativism and more variation in interaction patterns.

Corresponding to these differences in personality functioning are inter-community differences in personality structure (lower level of psychological integration) pointed out by Hallowell and also differences in most infant- and child-care techniques. Comparing families, it is suggested that less-acculturated parents promoted the functioning attributed to the historic personality in part by providing experience of greater success with completely responsive overt interaction. This type of experience is estimated only for families that retain a number of culture patterns connected with subsistence activities, kinship, and religion. With the greatest amount of acculturation, children are estimated to experience indifferent success with all of the interaction patterns studied and little parental interaction at all.

Since the critical family culture patterns are all clearly related to major adult roles, which differ greatly between the two communities; it is suggested that social organization at the community level may affect parent-child relations by affecting other adult roles.

Because of the nature of the data, this study is unable to confirm that an underlying introverted personality structure persists. The infrequent, limited influence of most children upon adults may point to such a structure. Its proposed determinants, including "social atomism" and the nuclear family type of household, are evaluated. The study points out that a process of "deculturation" – losses of culture patterns and non-adaptations – may be responsible for the absence of identifiable new trends in personality.

226 pages. $2.83. MicA 55-875

A COMPARATIVE STUDY OF MARGINAL SOCIETIES

(Publication No. 11,465)

Ferdinand Eastlake Okada, Ph.D.
Columbia University, 1955

Marginal societies are defined as those which are pre-agricultural and lacking in domesticated animals, thus being dependent on hunting, fishing, and collecting of vegetal and/or marine foods for subsistence. Some examples are Yahgan, Yaruro, Naskapi, Western Shoshoni, Bushmen, Andaman Islanders and Arunta.

The cultures of these and other societies, on whom there were at least the necessary minimum data, were analyzed and it was found that they could be divided into two broad categories, each with its own constellation of culture traits. These two categories are designated as cohesive and atomized, the difference between them being one of degree rather than of kind – as, for instance, in cohesive societies, the greater prevalence of communal shelters, the tendency toward formal chieftainship, or the virtual absence of sanctioned infanticide – and they are determined by the permanence and degree of social

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density obtaining in a given society. Social density is, in turn, influenced by cultural ecological, historical, and social factors.

Atomized Marginal culture is the outgrowth of a tendency toward family separatism, and cohesive Marginal culture is found in societies organized on a relatively strong supra-familial basis. Thus these two categories represent two levels of socio-cultural integration.

It is further held that they are developmental stages in cultural evolution. That one, the atomized, is simpler than the other does not imply a chronological priority; especially because of cultural ecological factors a Marginal society may be found at a cohesive stage of development without ever having passed through an atomized one. An atomized Marginal society, however, as it tends toward cultural complexity, must necessarily enter a cohesive stage because of the relatively high permanent social density needed to permit, develop and maintain cultural complexity. It is also held that change is not always in one direction: a cohesive culture may become atomized due to certain special circumstances.

190 pages. $2.38. MicA 55-876

BACTERIOLOGY

EFFECTS OF CERTAIN ANTIMETABOLITES ON THE PR8 STRAIN OF INFLUENZA A VIRUS AND THE GDVII STRAIN OF THEILER'S MURINE ENCEPHALOMYELITIS VIRUS IN MICE

(Publication No. 11,860)

Gerald Berg, Ph.D.
Syracuse University, 1955

The capacity of certain antimetabolites to produce antiviral or proviral effects under prescribed experimental conditions was studied.

The PR8 strain of influenza A virus was employed in most of the experimental work, though in some of the earlier experiments, Theiler's GDVII strain of murine encephalomyelitis virus was used.

The drugs tested for antiviral or proviral activity were benzimidazole, neotetrazolium chloride, 3-acetyl pyridine, a-picolinic acid, pantoyl taurine, aminopterin (two preparations), ethionine, sodium monoflouroacetate, and sodium malonate. With the exception of the neotetrazolium salt, all of the drugs tested were known to be metabolite antagonists in some animal or bacterial species.

The major method used for testing drugs involved determining and comparing the viral titers in the major infected organs removed from drug-treated and control animals fifteen or eighteen hours after initiation of infection. In some cases, the mouse survival technique was used also. No attempt was made to determine the mode of action of any compound, that is, to determine whether reductions in demonstrable viral titers were due to drug-induced depressions in viral multiplication rate or to some other direct or indirect effect of the drugs on the host cells or on the virus.

An attempt was made to determine whether variations in inoculum size were primarily responsible for the large degree of variation in the viral titers in major infected organs of similarly treated mice. For this purpose, growth curve and LD_{50} comparisons were made using one, two, and three drops of inoculum.

It was determined and concluded that:

1. Ethionine, sodium monoflouroacetate, and one preparation of aminopterin individually depressed the demonstrable titer of virus in PR8-infected mouse lungs by well over one log.

2. Benzimidazole reduced the demonstrable titer of virus in PR8-infected mouse lungs by a little less than one log. This drug, however, had no effect on the multiplication of Theiler's GDVII strain of murine encephalomyelitis virus in the mouse brain regardless of the method used for testing.

3. The results of experiments with small concentrations of neotetrazolium chloride suggested, but did not prove, that this drug increased the susceptibility of the mouse to infection with PR8 virus.

4. 3-acetyl pyridine, a-picolinic acid, pantoyl taurine, and sodium malonate had little or no demonstrable effect on the multiplication of PR8 virus in the mouse lung.

5. Variations in inoculum size (up to threefold) did not alter significantly the growth curve or LD_{50} of PR8 virus in mice.

The interpretations of the results were based on reproducibility and on the general tendency for individual observations in the control group to fall on one side of the mean of means (geometric mean of the geometric means of the treated and control groups) and for the individual observations in the treated group to fall on the other side in each experiment where a significant difference was believed to exist. Where no difference between means was noted, the distribution of the individual observations of both the control and of the treated groups were usually divided about equally on both sides of the mean of means.

It appears that the problem of determining the precise biochemical pathways essential for viral proliferation in the susceptible cells of animal hosts is difficult and that a more precise knowledge of cellular metabolism and antimetabolite activity, as well

as purer animal virus preparations, will be needed before great progress can be made in this direction.
148 pages. $1.85. MicA 55-877

THE PREPARATION OF TETANUS ANTITOXIN IN A STATE OF HIGH PURITY

(Publication No. 11,616)

Anthony Edward Bolyn, Ph.D.
Purdue University, 1955

Major Professor: Merwin Moskowitz

In 1942, Northrup (15) prepared diphtheria antitoxin in a crystalline state. This accomplishment evolved from previous reports (18, 20, 25, 26) which showed that highly purified preparations of diphtheria antitoxin could be obtained in reasonable quantity for further study by treatment of toxin-antitoxin floccules with a proteolytic enzyme in a slightly acid solution. A direct application of Pope and Healey's (20) procedure for diphtheria antitoxin to the preparation of tetanus antitoxin in a state of high purity resulted in a yield, approximately ten percent, almost too low to obtain antitoxin in reasonable quantity for further study. However, since some antitoxin was liberated from toxin-antitoxin floccules by pepsin, further studies to learn the optimum conditions for liberation of tetanus antitoxin from floccules by proteolytic enzyme were indicated. The results of these and additional studies are as follows:

1. A reciprocal relationship exists between enzyme concentration and incubation period for recovery of antitoxin from floccules. A certain minimum amount of enzyme is needed with a prolonged incubation period. On the other hand, an excessive amount leads to rapid digestion of not only the toxin but also the liberated antitoxin. The optimum amount of enzyme is therefore determined by the incubation period or time of enzyme action.

2. The optimum pH for recovery of antitoxin from floccules by pepsin is about 3.0. Hydrogen ion concentrations greater than pH 3.0 result in rapid digestion of not only the toxin but also the liberated antitoxin. At pH 3.5 the reaction time is slower than at pH 3.0 whereas at pH 4.0, it appears to be largely inhibited. The floccules are completely dissolved at pH 3.5 and below whereas at pH 4.0 they are only partially dissolved. The apparent inhibition of enzyme action at pH 4.0 may be due not only to lessened activity of pepsin but also to the insoluble state of the floccules.

3. Temperature effects the rate of enzyme action on tetanus antitoxin-toxin floccules. For proper laboratory regulation of the reaction using pepsin, it is advisable that the temperature be 25°C., or less. At higher temperatures the enzyme action may be so rapid that the liberated antitoxin as well as the toxin is digested.

4. The addition of electrolyte, as sodium chloride, reduces the solubility of the floccules at pH 3.0 resulting in the liberation of only a small amount of antitoxin by pepsin. Effective liberation of antitoxin occurs only when the floccules are in complete solution. Therefore, the reacting mixture should be free of electrolyte.

5. No apparent recovery of antitoxin occurs when floccules prepared from toxoid and antitoxin are treated with pepsin. It was found that toxoid and antitoxin are digested by pepsin at almost the same rate, whereas toxin is destroyed quite rapidly. These results may explain why no recovery of antitoxin was obtained when toxoid-antitoxin floccules were treated with pepsin. Since toxoid and antitoxin are almost equally susceptible to the action of pepsin, enzyme treatment of a toxoid-antitoxin complex could conceivably result in inactivation of the two proteins at about the same rate. Thus an appreciable excess of one protein over the other would not develop during enzyme digestion. Pepsin treatment of a toxin-antitoxin complex, however, could conceivably result in much more rapid digestion of the toxin protein than the antitoxin thus permitting an excess of antitoxin over toxin to develop. A test of such an enzyme treated preparation would then, in effect, demonstrate recovery of antitoxin.

6. The maximum recovery of antitoxin from pepsin treated floccules prepared from unconcentrated toxin is about twenty-five percent. The maximum recovery from pepsin treated floccules prepared from concentrated toxin, 500 Lf units per ml. or more, is about forty percent. This indicates that in the interaction of toxin and antitoxin, not all the resulting complex separates from solution as insoluble floccules. The results suggest that higher percent of the complex appears as in insoluble floccules when the interaction of toxin and antitoxin takes place in a concentrated mixture than in a dilute mixture.

7. Floccules prepared from overneutralized toxin-antitoxin mistures release more antitoxin when treated with pepsin than those prepared from neutral mixtures. This was demonstrated in the present studies by recovering antitoxin from floccules prepared from mixtures of various ratios of antitoxin to toxin. On the basis of the units of toxin used, the recovery of antitoxin from floccules prepared from a mixture of two to one of antitoxin to toxin (that is, two units of antitoxin for each unit of toxin) was about sixty-five percent, whereas the maximum recovery from neutral floccules was about forty percent.

8. Trypsin and papain are less effective than pepsin in the liberation of antitoxin from floccules. The results of these studies indicate that high concentrations of trypsin or papain with prolonged periods of incubation and very probably elevated temperatures would be required for effective liberation of antitoxin from floccules. Recovery of antitoxin with all three enzymes occurs only when the floccules are in solution and that is at about pH 3.0.

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9. The procedure suggested by the experimental studies for obtaining tetanus antitoxin in reasonable quantity by pepsin treatment of toxin-antitoxin floccules was readily confirmed.

10. A substantial quantity of inert precipitate may be removed from a pepsin treated toxin-antitoxin floccule solution by adjusting the pH of the solution to approximately 4.7 and heating in a water bath at 45° C. for a short time.

11. Ammonium sulfate fractionation studies of the antitoxin solution following removal of the inert precipitate at pH 4.7 with heat show that most of the antitoxic activity is associated with the precipitate collected at between forty and fifty percent ammonium sulfate saturation when the protein concentration of the solution is approximately three percent.

12. The protein fraction precipitated from solution at between forty and fifty percent ammonium sulfate saturation and then dialyzed had an antitoxic activity of 1,470 units per mgm. nitrogen by the flocculation test and 1,330 units per mgm. by the animal protection test. The preparation showed only one electrophoretic component when studied in a phosphate buffer of 0.20 ionic strength and pH 7.7 at a protein concentration of one percent; this component had a mobility of 0.93 X 10^{-5} cm^2/volt sec.

103 pages. $1.29. MicA 55-878

ELECTROPHORESIS AND BACTERIOPHAGE SUSCEPTIBILITY STUDIES ON A FILAMENT-PRODUCING VARIANT OF THE E. COLI B BACTERIUM

(Publication No. 11,579)

Charles Chester Brinton, Jr., Ph.D.
University of Pittsburgh, 1955

Introduction

It has long been known that bacteria may possess flagella of fairly well defined characteristics. However, it has only recently been noted that bacteria may have other appendages called "filaments" distinguished from flagella by their smaller diameter, shorter length, lack of undulation, and more irregular arrangement. Until the present time, knowledge of the filaments has been restricted to a few observations in the electron microscope. In the work to be described here, evidence for their existence as distinct surface structures of bacteria and evidence of their effect on the electrophoretic mobility of bacteria will be given, and some observations on their growth, genetics, and biological specificity will be made.

Methods

Strain B of Escherichia coli bacterium, which is sensitive to the bacteriophages T_1 to T_7, was the organism studied. The bacteria were grown in synthetic medium and diluted 1:10 with distilled water before introduction into the electrophoresis apparatus. The electrophoretic mobilities of samples of bacteria from the same culture were reproducible within 1%. The bacterial viruses T_1 to T_7 were assayed by counting the clear plaques formed when a mixture of virus and sensitive bacteria was incubated on a nutrient agar plate. The viscosity of suspensions of bacteria was estimated by measuring the outflow times in a capillary viscometer. Specimens for electron micrography were prepared by washing with distilled water, air-drying, and shadow-casting.

Results

The microscope electrophoresis studies revealed two kinds of organisms, "slow" bacteria with an electrophoretic mobility of about 2 microns/sec./volt/cm. and "fast" bacteria with a mobility of about 3.6 microns/sec./volt/cm. Intermediate values of mobility were not observed. The difference in mobility can be explained by assuming that the motion of the slow organisms is retarded by a surface irregularity. This was confirmed by viscosity measurements which showed the viscosity number of a suspension containing mostly slow bacteria to be several times as great as that of a suspension containing all fast bacteria. Slow organisms examined in the electron microscope were found to be well filamented while fast organisms possessed no filaments whatsoever. The filaments could be removed by agitation in a Waring Blendor, whereby previously slow organisms became electrophoretically fast. The de-filamented organisms were viable, and, after incubation and multiplication, filaments were produced and the organisms again became slow. De-filamented organisms were more susceptible to infection by bacteriophage, and a cell-free preparation of filaments inactivated bacteriophages T_2, T_4, and T_6 but not T_1, T_3, or T_7. The rate of spontaneous transformation of E. coli B bacteria from filamented to non-filamented form and vice versa was about 10^{-3} per organism per generation. The mobility of fast cells decreased sharply immediately after infection by a high multiplicity of T_2 bacteriophage. Filamented bacteria agglutinated and precipitated spontaneously in synthetic medium, while nonfilamented bacteria did not.

Summary and Conclusions

Certain strains of E. coli B bacterium may exist in two forms, filamented and nonfilamented. Attached to the surface of the filamented bacterium are from one to three hundred filaments about 150Å. in diameter and of greatly varying lengths. The presence of the filaments decreases the electrophoretic mobility of the bacterium by means of viscous drag. One form may change spontaneously to the other form at the relatively high rate of 10^{-3} per organism per generation. There is evidence to indicate that the filaments or an agent associated with them can specifically inactivate bacterial viruses. The filamented variants are similar to the semiresistant variants described by Wahl, and the presence of filaments may also be correlated with the rough-smooth colony morphology variation.

66 pages. $1.00. MicA 55-879

THE MECHANISM OF CELLULOSE DECOMPOSITION BY MESOPHILIC AEROBIC BACTERIA

(Publication No. 11,624)

Robert James Ellis, Ph.D.
Purdue University, 1954

Major Professor: H. W. Reuszer

Studies were carried out with two strains of Sporocytophaga myxococcoides, one strain of Cellvibrio vulgaris and two unidentified strains of Corynebacterium. Good growth of these strains was obtained in shake flasks of glucose or cellulose at a temperature of 28° C. and a pH of 7.0. Cellulose utilization was determined by difference of weight, while reducing sugar values were obtained by a copper reduction method.

Of a large number of compounds tested in agar or liquid cultures, two cytophaga strains gave visible growth only with cellulose, glucose, mannose, cellobiose, 2-ketogluconic acid, and carboxymethyl cellulose compounds having a low degree of substitution. In Warburg manometric experiments, one strain of cytophaga was found to utilize the following additional compounds as shown by appreciable oxygen uptake values: xylose, glucose-1-phosphate, lactic acid, citric acid, and glucuronolactone. Glucose-6-phosphate, fructose-6-phosphate, and hexose-1, 6-diphosphate were not utilized. The cellvibrio strain gave visible growth with dextrin, maltose, mannose, glucose, cellobiose, arabinose, xylose, and 2-ketogluconic acid. In Warburg studies, glucuronolactone and lactic acid were also found to be utilized. The corynebacteria gave visible growth with all the compounds tested except glucose-1-phosphate, pectin, pectic acid, corn holocellulose, hexose-1, 6-diphosphate, citric acid, oxalic acid, glycerophosphate, lactic acid, butyric acid, pyruvic acid, and diacetyl. In Warburg experiments, citric acid was slowly utilized. All the organisms utilized cellobiose at a higher rate than glucose in the Warburg determinations.

The presence of 0.125 or 0.25% of glucose, mannose, or cellobiose inhibited cellulose decomposition by the cytophaga and cellvibrio strains, but increased that by corynebacteria. Sorbitol, cysteine, cystine, citric acis, xylose, arabinose, glucuronolactone, and 2,4-dinitrophenol were each found to increase cellulose decomposition for at least one of the tested strains.

The effect of a large number of known enzyme inhibitors on the cellulolytic bacteria in media containing glucose or cellulose was studied. Inhibitors affecting the sulfhydryl groups were effective at concentrations 1×10^{-4}, 1×10^{-5}, 1×10^{-6} M, in inhibiting growth with both glucose and cellulose. These sulfhydryl inhibitors were iodoacetic acid, sodium arsenite, p-chloromercuribenzoate, phenylmercuric nitrate, potassium ferricyanide, quinone, mercuric chloride, copper sulfate, silver nitrate, and lead acetate. Reversal of the sulfhydryl inhibition did not occur with the addition of cysteine.

Of four reagents which inhibit phosphate transfer in the metabolism of carbohydrates, only sodium azide was found to completely inhibit the cellulose decomposition of all three strains at 1×10^{-4} M concentration. The mild oxidizing compound, cystine, and the mild reducing compound, glutathione, inhibited only the cytophaga strain at this concentration. It was also shown that p-nitrophenol, a reagent which forms an inactive complex with copper, inhibited cytophaga and cellvibrio at the concentration of 1×10^{-4} M. As a general rule, inhibition occurred at the same values for both glucose and cellulose.

Using paper chromatographic techniques for detection of reducing sugars, glucose was found present in small amounts in products of carboxymethyl cellulose decomposition by a strain of corynebacteria and cytophaga. For a cellvibrio only cellobiose and an unidentified compound having a very low R_G value were detected from carboxymethyl cellulose. Glucose was detected in the decomposition products of cellobiose for two cytophagas, one cellvibrio, and one corynebacterium strain. Chromatographic tests for a number of organic acids revealed the presence of none of these in the decomposition products of cellulose, carboxymethyl cellulose, and glucose for any of the bacteria used. 104 pages. $1.30. MicA 55-880

THE EFFECT OF X-RADIATION ON THE PROCESS OF PHAGOCYTOSIS AND THE BACTERICIDAL POWER OF THE BLOOD

(Publication No. 11,558)

Marvin Fishman, Ph.D.
Washington University, 1954

Chairman: Isaac Leo Shechmeister

The effect of X-radiation on three phases of phagocytosis in rats was studied: leucocyte migration, ability of leucocytes to ingest bacteria (phagocytic index), and the ability of these phagocytes to digest the engulped bacteria. The effect of X-radiation on the bactericidal power of rat blood was also investigated.

The leucocytes from rats, one day after exposure to 600r, had a similar rate and extent of migration as that exhibited by leucocytes from non-irradiated animals. Two days after irradiation the extent of leucocyte migration decreased, becoming more pronounced on the 5th post-irradiation day.

Phagocytic indices were determined on blood samples of normal and irradiated rats (600r) at various post-irradiation periods, using Micrococcus pyogenes var. aureus as the test organism. A significant higher-than-normal index was observed 2-12 hours after irradiation, followed by a below-normal index beginning on the 3rd and extending to the 13th day after irradiation. The same animals also showed a significant increase in surface phagocytosis 24 hours after irradiation, followed by a decrease 3-13 days after exposure.

The bactericidal power of rat blood against

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M. aureus was decreased on the 3rd post-irradiation day. This was due in part to the altered leucocyte function rather than to any serum factor(s). Decomplemented serum from irradiated animals, however, possessed a greater bactericidal activity than that exhibited by the decomplemented serum from non-irradiated rats. This bactericidal activity was destroyed by heating at 78° C for 5 minutes.

The bactericidal activity of extracts of leucocytes against M. aureus was affected by radiation in the same way as was the bactericidal power of whole blood; no effect occurred one day after irradiation, whereas, on the 3rd post-irradiation day, bactericidal activity against M. aureus could no longer be detected.

Studies of leucocyte migration were extended to rabbits. Irradiation of rabbits with 100r had no effect on this leucocyte migration. However, rabbits exposed to 500r or 800r exhibited a decreased leucocyte migration on the 3rd-5th post-irradiation days. This was followed by a normal migration, observed on the 6th-8th day after exposure. Another drop in migration occurred on the 10th-13th days after X-radiation, leading to a gradual recovery in the ability of the leucocytes to migrate. Normal activity was noted within 21-22 days after exposure.

The decrease in migration of leucocytes could not be explained by either the change in concentration of WBC or by the existence of any plasma factor(s).

The maximum effect of radiation on all three phases of phagocytosis and on the bactericidal power of the blood occurred on the 3rd-5th post-irradiation days, thus explaining, in part, the observed increase in susceptibility of rats to M. aureus infection evident at that time. 125 pages. $1.56. MicA 55-881

BACTERIOLOGICAL STUDIES OF CULTURED BUTTERMILK AS ASSOCIATED WITH pH LEVELS AND ACETYLMETHYLCARBINOL PLUS BIACETYL CONTENT

(Publication No. 11,846)

Wilburn Eldon Glenn, Ph.D.
State College of Washington, 1955

This study deals with three areas. Part I concerns the various factors affecting the acetylmethylcarbinol plus biacetyl content in cultured buttermilk. Part II concerns the development of a selective culture medium for the differentiation and enumeration of Leuconostoc citrovorum cultured in association with Streptococcus cremoris. Part III deals with the use of this medium in a study of the numerical relationships of the two species of starter bacteria as associated with changing levels of pH and acetylmethylcarbinol plus biacetyl, with and without additions of citric acid, sodium citrate and lactic acid to the milk.

Holding the finished product in storage at 40° to 45° F. showed that the flavor components, acetylmethylcarbinol plus biacetyl, continue to increase during the first 20 to 24 hours.

Bulk starters held in continuous incubation at 72° F., for periods up to 48 hours, were equal or superior to 16-hour old cultures commonly used in the manufacture of buttermilk.

Satisfactory levels of acetylmethylcarbinol plus biacetyl were produced at both 85° and 90° F. after 7.5 hours of incubation with the use of a 5.0 per cent inoculation. At 90° F. the quality of the body of the product was impaired.

Aeration of the product during the cooling process prior to storage did not increase the flavor components in the finished product.

A plate culture method is described for enumerating L. citrovorum when cultured in association with S. cremoris. This medium proved very satisfactory when used with two buttermilk cultures. With others it was not satisfactory, therefore, its limiting value is recognized.

Progressive changes were followed throughout the fermentation period in the numbers of L. citrovorum and S. cremoris, pH value and acetylmethylcarbinol plus biacetyl content. Observations were made using milk samples with and without additions of citric acid, lactic acid and sodium citrate. Citric acid was added at the rate of 0.15 per cent. Lactic acid was added in an amount sufficient to produce a pH value comparable to that produced by citric acid. Sodium citrate was added in an amount in which the citrate radical was equivalent to 0.15 per cent of citric acid.

At all stages of the fermentation, L. citrovorum represented only a small percentage of the total flora. At the time of inoculation this species constituted approximately 4.0 to 8.0 per cent of the flora. The lowest level occurred near the coagulating point of the milk. The greatest numbers were present in the samples to which citric and lactic acids were added. The greatest numbers of S. cremoris were present in the sodium citrate-treated and control samples. These trends were apparent early in the fermentation process. The divergency, in each case, increased as the fermentation progressed. The lower pH values produced by additions of citric and lactic acids apparently favored the growth of L. citrovorum.

No significant production of acetylmethylcarbinol occurred prior to coagulation of the milk. At this point the production rate accelerated rapidly, proceeded at a uniform rate for the next several hours and then continued at a declining rate until the maximum content was reached.

The production rate of acetylmethylcarbinol plus biacetyl was greatest in the citric acid-treated samples. Except toward the end of the observation period the samples treated with lactic acid gave the next greatest production of these compounds. As the fermentation progressed, the maximum yield of acetylmethylcarbinol plus biacetyl in the sodium citrate-treated samples approximated that of the citric acid-treated samples, while that of the control samples exceeded the lactic acid-treated samples.

95 pages. $1.19. MicA 55-882

ALTERNATE ROUTES OF CARBOHYDRATE METABOLISM IN PENICILLIUM CHRYSOGENUM Q176

(Publication No. 11,630)

Edward Charles Heath, Ph.D.
Purdue University, 1955

Major Professor: Henry Koffler

Evidence for the probable occurrence of both the Embden-Meyerhof-Parnas (EMP) reactions and the hexosemonophosphate oxidative pathway in Penicillium chrysogenum Q176 was obtained partly with whole cells, which had been grown in a synthetic medium containing glucose, and partly with cell-free preparations from such cells after they had been ground with alumina. Whole cells were permitted to respire on glucose-1-C^{14} in the presence and absence of 6×10^{-3} M arsenite, which causes an accumulation of pyruvate; the respiratory CO_2 and pyruvate were collected, and their specific activities were determined. In the presence of arsenite the CO_2 released had the same specific activity as the glucose which indicated the existence of a mechanism involving the preferential removal of the first glucose-carbon. In addition to this oxidative pathway also the EMP glycolytic mechanism must be functioning when arsenite-inhibited cells metabolize glucose-1-C^{14}, because the pyruvate that accumulates is labeled and contains all of its radioactivity in the methyl position.

To confirm the existence of the hexosemonophosphate oxidative reactions in this organism, the triphosphopyridine nucleotide (TPN) linked oxidation of glucose-6-phosphate and 6-phosphogluconate was studied with cell-free enzyme preparations from alumina-ground cells. The reduction of TPN in the presence of glucose-6-phosphate and 6-phosphogluconate was followed in the Beckman spectrophotometer at 340 mμ in the presence of the enzyme preparation suspended in phosphate buffer. TPN reduction did not occur with glucose or gluconate as the substrates even in the presence of added adenosinetriphosphate. Ribose-5-phosphate apparently also was metabolized, as indicated by the rapid disappearance of pentose from a reaction mixture containing ribose-5-phosphate as the substrate.

Cells were grown on media containing glucose-1-C^{14}, glucose-2-C^{14}, glucose-3,4-C^{14}, and glucose-6-C^{14} as the main sources of carbon, and the respiratory CO_2 (representative of four phases of the growth period) was collected and the radioactivity determined. The results of this experiment showed that the C_1-position of glucose was oxidized to a greater extent than any of the other positions tested.

The rates of oxidation of the various carbons of glucose were studied in a similar manner in the Warburg respirometer with cells which had been washed and resuspended in growth medium, and allowed to metabolize glucose-1-C^{14}, glucose-2-C^{14}, glucose-3,4-C^{14}, glucose-6-C^{14}, and uniformly-labeled glucose. Apparently the C_1 of glucose was initially attacked at a greater rate than the other positions of the glucose molecule. This was especially true in regard to the C_6 which would be equivalent to the C_1 if the EMP glycolytic mechanism were functioning exclusively; glucose-C_1 was oxidized at approximately twenty times the rate of glucose-C_6 during the first fifteen minutes after exposure of the cells to the labeled substrates.

A quantitative evaluation of the minimal participation of a C_1-selective mechanism was obtained by a comparison of the metabolism of glucose-1-C^{14} and uniformly-labeled-glucose by this organism; the specific activity of the CO_2 released when glucose-grown cells were allowed to oxidize glucose-1-C^{14} was greater than that of the CO_2 derived from uniformly-labeled glucose (of equivalent initial specific activity) One can calculate the relative contribution of glucose-C_1 (from glucose-1-C^{14}) and glucose-C_{2-6} (from uniformly-labeled-glucose) to the respiratory CO_2. The difference between these values represents the minimal percentage of the glucose that is metabolized via a C_1-selective mechanism. Experiments were performed with cells of various physiological ages and under different nutritional conditions, the results of which indicated that the C_1-selective mechanism participates significantly to the overall metabolism of glucose by this organism during vigorous growth.

126 pages. $1.58. MicA 55-883

THE NUCLEAR CYTOLOGY OF SALMONELLA TYPHOSA I. THE NORMAL MITOTIC CYCLE II. THE EFFECT OF COLCHICINE ON THE MITOTIC MECHANISM

(Publication No. 11,423)

Edward Joseph Minsavage, Ph.D.
University of Pennsylvania, 1955

Supervisor: E. D. DeLamater

The present study corroborates and supplements the previous work of DeLamater and his coworkers concerning the organization of the bacterial nucleus and its included chromosomes in a variety of bacteria. The elongation and contraction of the chromosomes during the divisional cycle is confirmed. It is felt that the intrinsic structure of the nucleus of Salmonella typhosa, which was shown to possess at least three visible chromosomes in the haploid state, shows its essential similarity to the nuclei of larger cells.

In the studies on the action of colchicine on the bacterial nuclei, it was considered desirable to have large, actively multiplying, more or less homogenous populations of bacteria as the test organisms since this would closely approach the conditions under which the action of the drug has been observed in plants and animals. Therefore, experimentation was confined to the logarithmic growth phase, since this is the period of most rapid multiplication, and the period in which the mitotic cycle would most likely be in evidence. The bacteria in most of the

experiments were 3.5 hours old when exposed to colchicine, at which time they averaged 136 million cells per ml. of medium. This arrangement allowed 2.5 hours for observation of nuclear changes due to the drug action.

A continuous culture method provided bacteria which varied somewhat in size from day to day. In this manner, cells of sufficient size for cytological study were obtained on some days.

The ribosenucleic acid in the control cells was rendered non-stainable with the nuclear dye, an azure A-SO_2 complex, after fixation with the vapors of osmium tetroxide, by hydrolysis for 7 to 8 minutes in 1N HCl at 60° C. Colchicine increased the optimal hydrolysis time in direct relationship to concentration and duration of exposure. In some cases the increase was as much as two-fold.

The oxidation-reduction balance which was most favorable for colchicine activity appeared to lie between complete aerobiosis and anaerobiosis, but has not yet been absolutely determined. The nuclei appeared to be normal at the two extremes of oxygen tension.

Cytologically, S. typhosa displayed at least four different, definable responses which could be controlled to some extent in their inducement by specific concentrations of, and duration of exposure to, colchicine. (a) Very long cells in which the chromosomes appear to have multiplied within the "nuclear membrane" so as to produce axial nuclei. (b) "Large bodies," fusiform cells, or "Y" shaped cells containing either one dense nucleus or what are interpreted as "polyploid" nuclei. (c) Round cells, containing nuclear material, either lying free or attached to one or two bacteria. (d) Cells which contain one or two large dense nuclei which appear to be "polyploid."

Colchicine was effective in a wide range of concentrations and exerted its influence upon the bacteria for only a few hours.

Since the response to colchicine by S. typhosa was similar to those shown in numerous plant and animal experiments, it was strongly implied that a mitotic apparatus exists in this organism.

70 pages. $1.00. MicA 55-884

THE EFFECT OF WHOLE-BODY X-RADIATION UPON CERTAIN ASPECTS OF NATIVE AND ACQUIRED IMMUNITY

(Publication No. 11,568)

Leo John Paulissen, Ph.D.
Washington University, 1954

Chairman: Isaac Lee Shechmeister

A study was made on the effects of whole body x-radiation on (a) the susceptibility of mice to Salmonella enteritidis and Escherichia coli and (b) on acquired immunity, using susceptibility of irradiated and immunized mice to S. enteritidis as a means of assay.

The post-irradiation susceptibility patterns of mice to S. enteritidis and E. coli were determined by subjecting different groups of mice to a single exposure of x-radiation at various dose levels and inoculating them with certain concentrations of the organisms at selected post-irradiation days. Two kinds of susceptibility patterns were found. The one was exemplified by the mice inoculated with E. coli after exposure to 350 or 450 r, and by mice inoculated with S. enteritidis after exposure to 350 r. This pattern was characterized by a maximal susceptibility occurring as early as eight hours to one day after irradiation and sustained for five to eleven days before declining. The other pattern was exemplified by mice inoculated with E. coli after exposure to 50 or 200 r, and was characterized by a susceptibility which reached a peak eleven days after irradiation and then declined.

Adjunct information relative to changes in weight, total and differential white blood cell counts, and survival time, obtained to measure the effect of radiation, revealed no consistent correlation, or at best only a rough one, between these factors and the susceptibility patterns of mice to the bacterial infections in question.

Using susceptibility of mice to S. enteritidis as a means of assay, the response of mice which were immunized, irradiated, and then challenged with graded doses of the organism, was compared with that of animals irradiated and challenged but not immunized. It was found that since x-radiation increased the susceptibility of immunized mice to a significantly lesser degree than that of the non-immunized mice, it did not destroy the immunity conferred by the immunization. The increased susceptibility of the immunized mice was, therefore, due to the injury of the native factors of resistance produced by the radiation.

The relative merits of using survival time and LD_{50} criteria in such a study as this were pointed out. It was necessary to consider this matter when it became possible to set up experimental conditions which produced data which could be assessed by both criteria but yielding apparently contradictory information. Appraisal of the criteria under these circumstances led to the recommendation that LD_{50} values should be obtained, if possible, because in covering several dose levels as opposed to one when using survival time, they admit of a broader interpretation. 126 pages. $1.58. MicA 55-885

PYRUVATE AND ACETATE METABOLISM IN ACETOBACTER SUBOXYDANS AND ACETOBACTER ACETI

(Publication No. 11,528)

M. R. Raghavendra Rao, Ph.D.
University of Illinois, 1955

The pyruvate metabolism of Acetobacter suboxydans and of Acetobacter aceti has been studied. Cell-free extracts of A. suboxydans decarboxylate

pyruvate to acetaldehyde which is oxidized to acetate. In contrast, extracts of A. aceti oxidize pyruvate to acetate by a pathway not involving acetaldehyde as an intermediate nor lipoic acid as a cofactor.

The pyruvic carboxylase of A. suboxydans and that of Pseudomonas lindneri have been purified and their properties studied. The purest carboxylase obtained from A. suboxydans had a Q_{CO_2} of 70,000. These two enzymes resemble their counterparts from yeast and wheat germ.

A study of the acetoin-formation by these carboxylases suggested the involvement of only a single protein or site in the route from pyruvate or from acetaldehyde, though the possibility of participation of more enzymes is not ruled out.

Both A. aceti and A. suboxydans possess DPN-linked ethanol dehydrogenases and Co A- and ATP-linked acetate-activating system. Acetaldehyde, in presence of A. aceti extracts, reduces both DPN and TPN; whether by two dehydrogenases or by a single non-specific dehydrogenase was not determined. A. suboxydans possesses TPN-aldehyde dehydrogenase; the presence of a DPN-linked aldehyde dehydrogenase was not observed since the cell-extracts contain a potent DPN-specific ethanol dehydrogenase. The re-oxidation of DPNH by the residual acetaldehyde, catalyzed by the DPN-alcohol dehydrogenase, may have masked the presence of a DPN-linked acetaldehyde dehydrogenase.

The oxidative potentialities of the two organisms are significantly different. Tricarboxylic acid cycle (TCAC) enzymes have been revealed in extracts of A. aceti, but not in A. suboxydans which lacks the condensing enzyme, isocitric dehydrogenase, the α-ketoglutarate- and succin-oxidase systems, and malic dehydrogenase, but possesses aconitase and fumarase. Of the TCAC enzymes, A. aceti contains much smaller amount of malic dehydrogenase than that necessary for the explanation of the overall rate of oxidation of acetate. The differences between the two organisms provide a biochemical explanation for the inability of the suboxydans group to oxidize acetate to completion.

A. aceti possesses two easily separable isocitric dehydrogenases; one DPN-linked and the other TPN-. Their purification, separation and properties have been described. The DPN-enzyme carries out an irreversible oxidative decarboxylation of isocitrate to α-ketoglutarate without involvement of oxalosuccinate as an intermediate. This enzyme, unlike the yeast DPN-enzyme, does not require added adenylic acid for activity, nor is it inhibited by azide and cyanide. The mechanism of action of all the DPN-isocitric dehydrogenases reported to date remains obscure. 77 pages. $1.00. MicA 55-886

UPTAKE OF RUBIDIUM AND PHOSPHATE IONS BY POLYSACCHARIDE PRODUCING MICROORGANISMS AS DETERMINED BY USE OF RADIOACTIVE ISOTOPE TRACERS

(Publication No. 11,849)

Edward Samuel Rorem, Ph.D.
State College of Washington, 1955

This study deals with the uptake of rubidium and phosphate ions by Leuconostoc dextranicum, Leuconostoc mesenteroides, Streptococcus salivarius and Azotobacter indicum. A. indicum could not be grown in large amounts without copious capsule or slime formation. The other microorganisms however, depending upon the carbon source present in the growth medium, could be grown either with or without abundant polysaccharide formation. The ion uptake of bacteria without abundant polysaccharide was compared with the uptake by bacteria associated with copious amounts of bacterial polysaccharide. The uptake of rubidium ions from solutions with radioactive $Rb^{86}Cl$ added as a tracer and uptake of phosphate ions from a solution tagged with carrier free $H_3P^{32}O_4$ by bacteria associated with copious polysaccharide was found to be from 2 to 20 times as great as the ion uptake observed with bacteria grown without abundant slime or capsule formation. Curves describing results from contact periods between the bacteria and radioactive solutions from 0 time to 3-1/2 hours were constructed. Uptake in milliequivalents of ions per 3×10^{14} microorganisms was plotted against the contact time between the bacteria and the ion solutions. The mechanism by which the polysaccharide binds the phosphate and rubidium ions was not determined.

The results of this study seem compatible with the hypothesis that the polysaccharide present in bacterial and higher plant cells is one of the important ion binding compounds responsible for initial ion uptake by the cell. Several workers have previously reported a high initial uptake followed by a loss or exchange of ions in uptake studies with microorganisms and higher plants. This phenomenon was consistently observed with living cells in this study and seemed to be intimately associated with the metabolism of the cell.

It seems probable that the capsule or slime of a bacterial cell, in addition to protection against adverse environmental factors, provides a means for growth and multiplication of the microorganism under conditions where the concentration of certain essential ions would be a limiting factor for an unencapsulated or non-slime forming microorganisms growth. 45 pages. $1.00. MicA 55-887

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

COMPONENT ENZYMATIC REACTIONS OF THE TRICARBOXYLIC ACID CYCLE IN ESCHERICHIA COLI

(Publication No. 11,575)

Robert Wayne Wheat, Ph.D.
Washington University, 1955

Chairman: Samuel J. Ajl

Untreated whole cell suspensions of Escherichia coli, when grown aerobically on sodium acetate as the principal carbon source, do not metabolize citric acid whereas dried cells and cell-free extracts do. In addition, cell-free extracts of aerobically grown cells were found to oxidize all other intermediates of the tricarboxylic acid cycle. The individual enzymes involved in these reactions were assayed, partially separated by ammonium sulfate fractionation and their cofactor requirements determined. The enzymes studied included the acetate activating and citrate synthesizing systems, aconitase, a triphosphopyridine nucleotide linked isocitric dehydrogenase, a diphosphopyridine nucleotide linked alpha-ketoglutaric dehydrogenase, succinoxidase, fumarase, a diphosphopyridine nucleotide and triphosphopyridine linked malic dehydrogenase, and oxalacetic acid decarboxylase.

Further studies revealed that E. coli when grown anaerobically on glucose and citrate as the principal carbon sources contains an enzyme which splits citric acid directly into acetate and oxalacetate. This enzyme, referred to in this work as the citrate splitting enzyme (CSE), was purified 15 to 20 fold. It does not require coenzyme A for its activity. Magnesium or manganese ions are necessary. The products formed as a result of citrate splitting enzyme action appear to be inhibitory to the reaction. With limited amounts of enzyme both the initial rate and extent of the reaction are proportional to the concentration of enzyme. With limiting substrate concentrations, the reaction appeared to go to completion.

It is concluded from the data obtained during this work that the tricarboxylic acid cycle is operative in aerobically grown E. coli. However, alternate pathways exist for the dissimilation of certain of the tricarboxylic acids, i. e., citric acid.

99 pages. $1.24. MicA 55-888

STUDIES ON AVIAN PLEUROPNEUMONIA-LIKE ORGANISMS

(Publication No. 11,550)

Franklin Henry White, Ph.D.
University of Illinois, 1955

This study was concerned with the culture, morphology, and serology of pleuropneumonia-like organisms (PPLO) isolated from chickens affected with chronic respiratory disease (CRD) and turkeys affected with infectious sinusitis (IS).

Cultural studies were undertaken to find a better medium for the cultivation of avian PPLO. Preliminary trials were conducted in a simple medium enriched with PPLO serum fraction (Difco), and growth was measured by the hemagglutination titer of the culture. It was found that avian PPLO grow better at 37° C. with the addition of 0.5 per cent maltose, than at 37° C. without maltose or at 42° C. with or without maltose. No difference in growth was observed over a pH range from 6.8 to 8.6. It was also found that growth was much more regular in liquid media than on solid media.

The influence of different peptones and the usual bacterial growth stimulants on the growth of avian PPLO was also determined. Two strains, one of chicken and one of turkey origin, were used as the test organisms. Media tested were beef heart infusion broth plus the progressive addition of trypticase, beef extract, PPLO serum fraction, yeast extract and maltose. Other media were prepared by substituting proteose peptone #3 or neopeptone as the principal peptone. Also tested were PPLO broth (Difco), brain heart infusion broth and phenol red broth, each enriched with serum fraction and yeast extract.

It was found that proteose peptone #3 and trypticase were of about equal value in supporting growth of avian PPLO, while neopeptone was definitely poor. PPLO broth and brain heart infusion broth were equal to trypticase or proteose peptone #3. Phenol red broth compared favorably with the other media tested. It appeared that the basic medium was not very critical, but that bovine serum fraction was the important stimulatory factor for the growth of avian PPLO.

Three strains of avian PPLO were examined with the electron microscope. Many single cells were observed and they were from less than 0.2 to 0.5 micron in diameter. The cells were irregularly round with rough surfaces. In addition to single cells, two different sizes of filamentous forms were observed, but they were much less numerous. The larger filaments contained cells the size of many of the single cells. The smaller filaments appeared to contain single cells which were less than 0.1 micron in diameter. Both filaments were of such a sac-like structure as to indicate that the single cells were released by them.

Serological work showed that avian PPLO caused hemagglutination (HA) of chicken and turkey red blood cells, and that hemagglutination-inhibition (HI) occurred with sera from experimentally infected birds, but not significantly with sera from normal birds. The preliminary findings were confirmed by the preparation of standardized antigens with six strains of avian PPLO.

The development of PPLO HI antibodies in chicks inoculated with CRD or IS strains of PPLO was followed for 12 weeks after exposure. With sera from birds inoculated with the IS strain the titer reached a high of 32 at four weeks with a decline at eight weeks. With the CRD inoculated group the PPLO HI titers were irregular until six weeks, at which time a gradual increase began which reached 64 at 12 weeks.

Certain field cases of suspected CRD which had been submitted for diagnosis were used in an attempt

to correlate the history, symptoms and lesions to the PPLO HI titers. There were complicating factors present in some flocks, such as vaccinations and other bacterial or viral diseases, but in most cases where CRD was suspected, a positive PPLO HI was obtained. 95 pages. $1.19. MicA 55-889

BOTANY

STUDIES ON THE UTILIZATION OF GLUCOSE BY THE FLAGELLATE, EUGLENA GRACILIS

(Publication No. 11,392)

Melvin M. Belsky, Ph.D.
University of Pennsylvania, 1955

Supervisor: D. R. Goddard

The "acetate flagellates" have been characterized by their ability to grow on media containing acetate, simple acids, or alcohols as carbon sources, and by their general inability to utilize sugars, though they possess polysaccharide reserves. This inability to utilize external sugars for growth has tentatively been explained by the postulation of a lack of either hexokinase or phosphoglucomutase in these organisms. Recently, however, it has become possible to grow Euglena with glucose as substrate. This dissertation reports the results of experiments which were designed to help clarify the question of the mechanism of carbohydrate utilization by an "acetate flagellate," Euglena gracilis.

The nutritional experiments reported here indicate that this organism can utilize glucose, fructose, sucrose, and galactose for growth in darkness with the latter two substances possibly being utilized adaptively. Several inconsistencies have been noted concerning conditions necessary for glucose utilization as reported by others and as observed during this study. Specifically, these inconsistencies concern CO_2 tension and previous history of the cells. Additional nutritional studies indicate that neither gluconic acid, 2-ketogluconic acid, nor D-ribose could be substituted for glucose as carbon source.

No identifiable substance could be shown to accumulate in Euglena medium following growth on glucose, with the methods used here.

On feeding this organism uniformly labeled C^{14} glucose, and after chromatographing and radioautographing the cell extracts, an unusual pattern of intermediates is visualized. Aside from the glucose which was fed, only one or two other radioactive compounds could be detected. One of these compounds is thought to be either galactose or sedoheptulose, and the other is suspected of being uridine diphosphate glucose.

No hexokinase activity could be demonstrated using several different cell-free preparations of Euglena, and employing a wide variety of assay conditions. However, experiments with cell-free preparations did indicate the presence of both glucose-6-phosphate dehydrogenase and 6-phosphogluconic acid dehydrogenase in this organism. Similar experiments failed to provide evidence for the existence of glucose dehydrogenase.

The implications of these findings are discussed, with particular reference to previous studies involving carbohydrate utilization by this organism.

52 pages. $1.00. MicA 55-890

CELLULOLYTIC ACTIVITY AND GROWTH CHARACTERISTICS OF PYTHIUM IRREGULARE

(Publication No. 11,621)

Elwood Oliver Dillingham, Ph.D.
Purdue University, 1955

Major Professor: Dr. C. L. Porter

Pythium irregulare, a member of the lower Phycomycetes, was isolated in pure culture from soil. Antibiotics were found helpful in the purification procedures but were not adequate in themselves for purification of aquatic Phycomycetes.

The survival of P. irregulare in sterile muck and clay soils was investigated. The fungus colonized muck soil more readily and for a longer period of time than clay soil. The organism did not withstand severe desiccation, but under moderate conditions in both muck and clay soils it was found viable in soil-water cultures thirty days after viable vegetative mycelium was no longer detected. Apparently, the sexual reproductive structures were capable of surviving periods unfavorable to the growth of vegetative mycelium.

P. irregulare was found incapable of attacking lignin per se but capable of utilizing degradation products associated with brown rot.

The ability of P. irregulare to utilize cellulose xanthate cellophane was studied. It was concluded that the organism was capable of utilizing cellulose xanthate in the presence and absence of plasticizing materials and that the rate of attack was dependent upon the levels of glucose, pH and nitrogen source. Low concentrations of glucose increased the weight loss of the cellulose xanthate. The plasticizing materials in the cellophane were utilized at a higher rate than the cellulose xanthate but apparently did not interfere with the attack on the xanthate. The alkali

solubility of the xanthate was increased by enzymatic attack by the fungus. The rate of absorption of alkali by the cellophane was high in the presence of plasticizing materials. Although ammonium sulfate produced a greater dry weight of mycelium than monobasic ammonium phosphate, it did not produce a correspondingly high decrease in weight loss of the cellophane as was true for the latter and other nitrogen sources studied. Ammonium nitrate at pH 6.0 produced the greatest dry weight of mycelium and the greatest weight loss of cellophane.

An investigation of the ability of P. irregulare to degrade eight ounce cotton duck was carried out using breaking strength loss as an estimate of degradation. The factors influencing degradation of the sized and desized fabric were similar to those found for degradation of cellophane but the rate of degradation of fabric was much lower. Cellobiose was found to inhibit breaking strength loss effectively.

A cell-free extract of P. irregulare was found capable of attacking cellulose xanthate and hydrocelluloses prepared from cotton duck. The activity of the filtrate was effectively inhibited by cellobiose and was quite low on less degraded substrates. It was concluded that the activity was due to C_x rather than C_1 enzymes.

The colonial respiration of P. irregulare grown on various cellulosic substrates was determined using the Mandels-Siu differential type respirometer. The influence of the type and age of inoculum, the concentration of the substrate, and the pH of the medium was determined under a number of different conditions. The respiration data supported the conclusion that P. irregulare was capable of utilizing cellulose as a sole source of carbon but attacked high grade cellulose, i.e., Whatman No. 1 filter paper, at a low rate. Chromic oxide and salicylic acid effectively inhibited the respiration of the fungus, the chromic oxide being more toxic.

The nature of colonial growth and respiration were studied using a modification of the Mandels-Siu differential type respirometer. It was found that the respiration of the fungus colony could be divided into three phases: a lag phase, an exponential phase, and a linear phase. Over the exponential phase, the respiration of the colony was in general agreement with a mathematical model for respiration of the colony. An experimental determination of the oxygen uptake of the colony indicated a "physiologically young" region of growth consistent with that estimated from the data of the exponential phase of respiration using the mathematical model.

The results of the investigation indicated that P. irregulare was capable of active degradation of cellulosic materials. There seems little doubt that further investigation of the members of the lower Phycomycetes will show that they play a more prominent role in cellulose and, perhaps, lignin decomposition than has heretofore been attributed to them.

181 pages. $2.26. MicA 55-891

VARIATION OF THE COMMON BEAN (PHASEOLUS VULGARIS L.) IN CENTRAL AMERICA

(Publication No. 11,560)

George Frederick Freytag, Ph.D.
Washington University, 1955

Chairman: Edgar Anderson

A report of early research of various kinds on the common bean is summarized. Such a survey indicates that the first prerequisite for bean research is a thorough knowledge of the origin and relationships of the material under investigation. That such an objective has not previously been achieved is indicated from a review of the major publications on bean classification.

The present study is an attempt to set up a system whereby the variation in a collection of 100 various Central American beans may be studied effectively. These collections were grown and observed for two years in an experimental plot in Honduras. Herbarium specimens were preserved and observations recorded which serve as the basis for the measurements used. When the results are analyzed by scatter diagrams one can observe character associations which indicate that bean variation has originated from at least two major sources. In their more or less pure forms these two sources are indicated as: 1) P. vulgaris complex – an elongate seeded bean of determinate plant type; 2) an unknown species here designated as Tropical Black – a small equidimensional black-seeded bean, short and vining, and with heavily purple pigmented flower and plant. Descriptions are given for these extreme types and for commonly occurring intermediates in terms of the characteristics associated with the extreme complexes.

Outstanding among the types commonly encountered in Central America at the present time are the Honduran Red Beans and the Black seeded beans of the neighboring Republics. The possible origins, interrelationships, and recombinations for these types are discussed.

That this method might be of value to certain fields of bean investigation is indicated.

136 pages. $1.70. MicA 55-892

A SUMMARY OF THE GENUS GOCHNATIA INCLUDING A REVISION OF THE WEST INDIAN SPECIES WHICH COMPRISE THE SECTION ANASTRAPHIOIDES

(Publication No. 11,301)

Roy Newell Jervis, Ph.D.
University of Michigan, 1954

The purpose of this study is to clarify the nature of a group of West Indian plants known as the genus Anastraphia D. Don (family Compositae) so that they can be used to help explain the distribution of floras

in the Caribbean region. Such a study is important because few groups of Caribbean plants are well understood.

The first part of the study presents the past history of the genus. Based on an exhaustive search of pertinent literature and actual comparison of type specimens, it shows that the West Indian plants which were originally assigned to the genus Anastraphia do not belong to that genus, but, instead, to the genus Gochnatia H. B. K., other species of which are found in Mexico, South America and India. The type specimen for the type species for Anastraphia D. Don could not be located, but the original description of it varies from the plants of the West Indies which had been assigned to that genus.

The position of the genus Gochnatia and its general relationships in the subtribe Gochnatiinae are discussed, as well as the relationship of the Gochnatiinae to the other subtribes in the Mutisieae. A division of Gochnatia into six sections is presented, with the West Indian species forming a new section Anastraphioides. The Indian species, formerly known as the genus Leucomeris, form the section Leucomeris. The dioecious species (formerly the genus Moquinia DC.) are made the section Moquinia. The remaining species belong to the sections Gochnatia, Hedraiophyllum, and Pentaphorus, but lack of study of these species prevents an accurate presentation of their limits.

A revision of the section Anastraphioides is presented, with twenty-five species described. Detailed drawings of important vegetative parts and key floral parts, including pollen grains, are included for each species to emphasize similarities and differences. The Mexican species are described in lesser detail, but each is accompanied by detailed drawings of key parts. The remaining species of Gochnatia are listed with a summary of the nomenclature, including synonymy, and brief distributional data for each.

A hypothesis concerning the evolutionary development and migration of the genus Gochnatia in the West Indies is presented. Modern distribution of the group is the result of migration over land masses from Mesozoic time. Present day factors tend to limit rather than facilitate further migration.

As a result of this study, the revision reduces the West Indian species of Gochnatia from thirty-seven to twenty-five. Of these, the species originally placed in Anastraphia are transferred to Gochnatia. Legitimate epithets which had been ignored are restored. It is shown that Gochnatia ilicifolia Lessing is a valid species and differs from the Cuban species hitherto known as Anastraphia ilicifolia; the latter is described as Gochnatia sagraeana. Four other species are reduced to varieties of Gochnatia microcephala. Lectotypes of the species described by Urban are chosen to replace holotypes destroyed at Berlin in 1943. The section Anastraphioides is created, section Leucomeris is re-established, and section Moquinia established by transfer. One species is shown to have been incorrectly called Gochnatia; it is transferred as a new combination, Perezia glomeriflora.

The conclusions of this study are: 1) to Gochnatia, which includes plants from India, Mexico, and South America, must be added the twenty-five species which comprise the section Anastraphioides in the West Indies; 2) the nature of the West Indian species and their distribution indicate that they were widespread in the Caribbean region as early as late Mesozoic; 3) the genus Anastraphia D. Don is South American of unknown nature.

239 pages. $2.99. MicA 55-893

THE DEVELOPMENT OF BEAN SEED

(Publication No. 11,417)

Jakob Rainer Loewenberg, Ph.D.
University of Pennsylvania, 1955

Supervisor: D. R. Goddard

The development of bean seed from eleven days after flowering to maturity is described in biochemical terms on an organ and cell basis. Single sets of measurements on individual beans indicate that the greatest gains in dry weight, fresh weight, nitrogen and phosphorus occurred three to five weeks after flowering. This period of greatest seed growth coincided approximately with the period of most rapid oxygen uptake per bean. As the seed matured, the percentage of dry weight increased from 15 at eleven days past flowering to 85 at forty-six days after flowering, the Q_{O_2} decreased from an initial value of six to nought, and the ratio of the dry weight of the cotyledons to that of the entire bean seed grew from 0.05 to 0.9.

Cell counts on the developing cotyledons indicated that cell division ceased before the period of greatest seed growth began, about three weeks after flowering. Although an increase from 360,000 cells twelve days after flowering to a final value of 2,600,000 cells was observed, it represents less than three cell generations; the first eighteen cell generations had occurred by the twelfth day. On the assumption that fertilization occurred on the day of flowering, for the following twelve days a mean rate of one cell generation every fifteen and a half hours was calculated; such a rate is comparable with those that have been found for pea and corn root cells.

The average bean cotyledon cell, like the entire seed, grew but little until cell division had ceased in the cotyledons; it then increased its size greatly.

A comparison of cells of various origins shows that despite tremendous differences in their fresh and dry weights, the rates of oxygen uptake per cell are of the same order of magnitude.

48 pages. $1.00. MicA 55-894

PHOTOSYNTHESIS AND RESPIRATION OF THE PHYTOPLANKTON IN SANDUSKY BAY

(Publication No. 12,001)

Arthur George McQuate, Ph.D.
The Ohio State University, 1954

The photosynthesis and respiration of the phytoplankton in Sandusky Bay, Ohio, was studied from February to mid-June, 1954. Sandusky Bay is an embayment on the southern shore line of Lake Erie which, in contrast to the waters of western Lake Erie, presents conditions of extreme turbidity. This is due to erosion of its clay banks by wave action and to the discharge of tributaries that drain a rich agricultural area. The concentration of suspensoids was 10 times greater than in western Lake Erie, and the average depth of the euphotic zone was 0.7 m. Oven-dry suspensoids averaged 121.8 mg per liter and ash-free dry weight of suspensoids averaged 11.78 mg per liter. Phytoplankton populations ranged from $0.007 \times 10^{10}\mu^3$ to $5.73 \times 10^{10}\mu^3$ per liter and averaged $1.3 \times 10^{10}\mu^3$. Diatoms comprised 95 per cent of the population. The distribution of phytoplankton populations in relation to decimal reduction distance (DRD, depth associated with 10 per cent surface light) revealed that when the DRD was reduced to less than one-third of the total depth, light became severely limiting and the size of the standing crop was largely determined by light penetration; but when the DRD was greater than one-third of the water column, factors other than light supply exerted a controlling influence on the size of the standing crop.

The method used for determination of rates of photosynthesis and respiration consisted of measuring the change in pH of water samples upon removal of carbon dioxide by photosynthesis or upon evolution through respiration. As a check against the carbon dioxide data, simultaneous measurements were made of oxygen evolution by photosynthesis and oxygen consumption through respiration.

The average photosynthetic rate in optimal light, based on CO_2 consumption was 15 micromoles/hr/$10^{10}\mu^3$; the ratio of CO_2 consumption to O_2 evolution (CO_2/O_2) was 0.87. Related to ash-free dry weight of suspensoids, the photosynthetic quotient (CO_2/O_2) was 1.04. On an area basis, the total productivity was 144 millimoles of O_2/m^2/day, or the equivalent of 4 grams of glucose per square meter per day. Photosynthetic rates per unit of plant volume were inversely proportional to population. Phenomenal photosynthetic rates at periods of low levels of phytoplankton population suggested that important quantities of organisms escaped detection in microscopic examination under 100x magnification. Chemosynthetic and photosynthetic bacteria may be responsible for this phenomenon.

Respiration rates as measured by CO_2 evolution averaged 4.7 micromoles/hr/$10^{10}\mu^3$; based on O_2 consumption, the average was 1.7 micromoles/hr/$10^{10}\mu^3$. The respiratory quotient was 2.7. Based on ash-free dry weight of suspensoids, CO_2 evolution was 0.88 micromoles/hr/mg.; O_2 consumption was 0.267 micromoles/hr/mg.; the respiratory quotient was 3.3, indicating CO_2 evolution considerably in excess of O_2 consumption. This phenomenon suggests that a microbial fermentation or some chemical reaction occurs causing production of CO_2 or some other acid without absorbing O_2. The rates of oxygen consumption were inversely proportional to temperature.

The correlation of CO_2 consumed per liter with ash-free dry weight of suspensoids was 0.604; with phytoplankton volume it was 0.388. The correlation coefficient of O_2 evolution per liter with ash-free dry weight of suspensoids was 0.413; with phytoplankton volume it was 0.457. These coefficients of correlation indicate that phytoplankton volume and ash-free dry weight are of the same order of reliability as indices of productivity in Sandusky Bay. These correlations indicate, further, that measurements of photosynthesis by means of pH determinations are as reliable as those based on oxygen measurements. 45 pages. $1.00. MicA 55-895

PATHOLOGICAL AND MORPHOLOGICAL EFFECTS OF USTILAGO TRITICI (PERS) ROSTR. ON WINTER WHEAT

(Publication No. 11,523)

Richard Earl Ohms, Ph.D.
University of Illinois, 1955

The time of infection of winter wheat with Ustilago tritici (Pers) Rostr. was during flowering after the process of fertilization. The chlamydospores on the pistils germinated before pollination and invaded the anthers, but no penetration of the pistil was observed until after fertilization had occurred. The infection hypha penetrated the stigma, grew downward through the style, between the inner integument and inner epidermis, through the micropyle, and into the endosperm and embryo. After passing through the micropyle the hyphal type changed from a non-branched, thread-like, intercellular growth to a branched, much thickened, knobby type growing intra- and intercellularly. The path was the same in both resistant and susceptible varieties and no difference was noted in the frequency of embryo infection.

Inoculations made at daily intervals before and after anthesis resulted in a decrease in both the percentage of the embryos infected and the amount of mycelia in the embryos.

The hyphae grew and remained with the growing points of the susceptible Wabash seedlings but were left behind in the resistant Kawvale seedlings. The hyphae extended into the growing points of Wabash and were concentrated at the nodes and in the vascular tissues of both Wabash and Kawvale seedlings.

Resistance was of two types; over-susceptibility (Wabash to race 11) and the Kawvale type. In the over-susceptible reaction, the seedlings either failed to emerge or died when in the third to fifth foliar leaf stage. There was an indication the death was

due to an interaction of soil organisms and the smut hyphae. In the Kawvale type of resistance, the growing points of a seedling would be free of the mycelia while the scutellum was infected. There were good indications that this was due to the slow growth of the infection hyphae in the resistant variety.

The third internode was shortened in both infected resistant and susceptible seedlings which contained scutellar infection. In the susceptible seedlings, the shortening was more pronounced and a correlation was found between the amount of hyphae present in the embryo and the degree of internode shortening.

In Kawvale, when the third internode was shortened, the fourth internode would elongate so that the apical growing point would be at a normal soil depth at the third foliar leaf stage. There was no internode elongation in the susceptible variety at the beginning of the third foliar leaf stage. However, at the fifth foliar leaf stage the fourth or fifth internodes had elongated in many of the infected susceptible seedlings even though the fourth and fifth nodes and the growing points contained hyphae. Thus, the Kawvale type of resistance could be separated from the susceptible internode reaction at the beginning of the third foliar leaf stage but not at the fifth foliar leaf stage. The oversusceptible reaction could be separated from the susceptible reaction at the beginning of the fifth foliar leaf stage.

66 pages. $1.00. MicA 55-896

A MONOGRAPHIC STUDY OF THE WEST INDIAN SPECIES OF PHYLLANTHUS

(Publication No. 11,370)

Grady Linder Webster, Ph.D.
University of Michigan, 1954

This work presents the results of a study of the West Indian species of Phyllanthus (Euphorbiaceae), including comparisons with Old World species and representatives of genera closely related to Phyllanthus. The technique of the work consisted in making a detailed taxonomic revision of most of the West Indian species in conjunction with morphological and anatomical studies. This was supplemented by collection of material and study of populations in the field.

In the taxonomic revision, the 93 species of Phyllanthus occurring cultivated or wild in the West Indies are grouped into 22 sections. Keys to the West Indian genera of Phyllantheae, the sections of Phyllanthus, and the individual species are included. Most of the species are described in detail and the distribution of nearly all is indicated by means of maps and citation of specimens. Nine sections, three subsections, six species, and three varieties are described as new.

The remainder of the work, comprising the general observations, includes a review of the historical development of generic concept in the Phyllanthinae, and an appraisal of the work of the most important monographer, Jean Mueller. This is followed by a morphological and anatomical survey, with particular emphasis on the structures of general morphological interest or taxonomic importance. The latter include the branching patterns, pollen grain sculpturing, and type of fruit.

An analysis is presented of the geographic distributions of the West Indian species. This includes an appraisal of the relative importance of ecological and historical factors. The phytogeographic relationships between the Caribbean islands are shown to be complex, but there is a fairly definite grouping into a Greater Antillean and Lesser Antillean Phyllanthus-flora. The former is a center of evolution in its own right, but the latter is scarcely more than a transition zone populated both from the Greater Antilles and from South America.

On the basis of the geographic distributions, and of the presumed relationships as shown by morphological comparisons, the affinity of many of the West Indian species appears to be with species at present occurring in southeastern Africa and India. Some West Indian species are closely related to ones in Madagascar. It appears necessary to assume that the migrations took place from Africa to the West Indies in very ancient times, probably in the Mesozoic era, across a land-connection no longer existing.

Morphological evidence indicates that study of classification and phylogeny in Phyllanthus will be difficult because of the extensive convergent evolution which has occurred. Such characters as phyllanthoid branching, cauliflory, drupaceous fruit, and the synandrium appear to have risen independently in two or more lines. As a result, taxonomists have been misled into classifying unrelated plants together. Even when Margaritaria and Cicca are segregated as independent genera, many of the groups remaining within Phyllanthus are not closely related. Additional study may necessitate changes in the generic circumscription. 598 pages. $7.48. MicA 55-897

CHEMISTRY, GENERAL

DECAY SCHEME AND CHARACTERIZATION STUDY OF RADIOACTIVE PRODUCTS OF DEUTERON REACTIONS

(Publication No. 11,258)

Wayne Alexander Cassatt, Jr., Ph.D.
University of Michigan, 1955

The gamma-ray spectrometer, beta-ray spectrometer and coincidence counter assembled and put into operation for this investigation are described.

New or more precise nuclear data are given for the radioactive isotopes V^{47}, Y^{85}, Y^{92}, Ag^{104} and In^{107}, all of which were obtained by chemically separating these elements from targets bombarded with 7.8 Mev deuterons in the University of Michigan Department of Physics cyclotron or the Argonne National Laboratory cyclotron.

Previously unreported gamma-rays were observed and their energy measured in the case of V^{47}, Y^{92}, Ag^{104} and In^{107}. Less definite evidence for other gamma-rays emitted by Y^{85} and V^{47} was obtained. A direct measurement of the half-life of Y^{85} gave what is felt to be a more accurate value than is found among the widely varying values reported in the literature. Coincidence measurements are reported for the first time for Y^{85}, Y^{92}, Ag^{104} and In^{107}. Assignment of the observed radiation to In^{107} and Ag^{104} was aided by the use of cadmium oxide targets enriched in Cd^{106}. Upon the basis of the data obtained and certain other information found in the literature, decay schemes are suggested for Y^{92}, Ag^{104} and In^{107}. The information obtained on the gamma radiation emitted by V^{47} and Y^{85} seems to be in disagreement with data recently reported by other workers.

166 pages. $2.08. MicA 55-898

A POLAROGRAPHIC STUDY OF CERTAIN ORGANIC COMPOUNDS: STUDIES OF PYRIDINE, QUINOLINE, AND RELATED COMPOUNDS. STUDIES OF ALDEHYDES AND THEIR REACTIONS WITH AMINO ACIDS. STUDIES OF ORGANIC REAGENTS THAT ARE USEFUL IN ANALYTICAL CHEMISTRY

(Publication No. 10,985)

Daniel Remsen Norton, Ph.D.
Princeton University, 1948

The purpose of this thesis is to provide fundamental chemical knowledge that will lead to the development of analytical methods. A polarographic survey was made of a number of compounds that are of interest from a pharmaceutical and biological standpoint. The spectrophotometric method was utilized to give added information concerning these compounds.

A summary of the theory and technique of organic polarography serves to orient the reader for the interpretations that follow. A precision study of anode potentials illustrates the importance of using a well poised reference electrode. An original and useful design of a saturated calomel electrode is described.

A study of the catalytic effect of pyridine in lowering the overvoltage of hydrogen at the dropping mercury electrode has been accomplished. A series of experiments, performed in well buffered, poorly buffered and unbuffered medium indicate the true catalytic nature of the reduction process. In contrast to pyridine it was found that the picolines, 2-hydroxypyridine, and sulfapyridine are inactive in lowering the overvoltage of hydrogen. The reduction of pyridine monocarboxylic acids substantiates the data obtained by other investigators. A study of the polarographic behaviour of pyridine 2,3-dicarboxylic acid is included. The catalytic effect of pyridine is attributed to pyridinium ion and the relative absence of this effect in substituted pyridine compounds is related to the lower dissociation constant of the corresponding base.

A polarographic survey of quinoline and related compounds is presented in an effort to differentiate between catalytic and true reduction processes in the quinoline series; to compare the results obtained for pyridine, bipyridyl, quinoline, isoquinoline, acridine, and orthophenanthroline; and to present useful information concerning the analytical potentialities of compounds that have not been previously studied by the polarographic method. The polarographic survey includes information on the following compounds: quinoline, isoquinoline, 3-methylisoquinoline, acridine, lepidine, quinaldinic acid, 8-nitroquinoline, 2-hydroxyquinoline, 7-iodo-8-hydroxyquinoline-5-sulfonic acid, quinine hydrochloride, atabrine, and 6-methoxy-8-(4-isopropylamino-1-methylbutylamino)-quinoline. Spectrophotometric curves of the last compound were recorded over a wide range of pH.

Polarographic studies were made of aldehydes and their reactions with amino acids. The reductions of the following aldehydes were studied at the dropping-mercury electrode: formaldehyde, chloral hydrate, benzaldehyde, p-dimethylaminobenzaldehyde, furfuraldehyde, salicylaldehyde, and o-phthalaldehyde. Of these compounds only o-phthalaldehyde reacted with an amino acid to cause suppression of the aldehyde wave. The reaction between o-phthalaldehyde and glycine, alanine, tryptophane, and histidine in a borate buffer at pH 10.5 was made the basis of an analytical determination of these amino acids.

A spectrophotometric investigation of salicylaldehyde showed that its absorption band is shifted

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

toward a longer wave length and that the intensity of the absorption is greatly increased when an aqueous solution of this aldehyde is made alkaline. It is pointed out that this relationship has important applications in the analysis of salicylaldehyde. Another spectrophotometric investigation was made of the following proteins: tyrothricin, gramacidin, and tyrocidine. It was shown that the characteristic absorption in the ultraviolet obeyed Beer's Law and that the relationship could be used for the analysis of these proteins.

Associated with these studies is one in which a number of organic reagents were examined by the polarographic method in an effort to determine their potentialities for the amperometric titration of metals. Information of the following reagents is presented in this chapter: alpha, alpha'-bipyridyl, orthophenanthroline, dimethylglyoxime, alpha-benzoinoxime, cupferron, cacotheline, 2,4-dinitrophenylhydrazine, quinaldinic acid, and 7-iodo-8-hydroxyquinoline-5-sulfonic acid.

139 pages. $1.74. MicA 55-899

WET-PROCESS AUTORADIOGRAPHY APPLIED TO METALLURGICAL STUDIES

(Publication No. 11,363)

George Coffin Towe, Ph.D.
University of Michigan, 1954

The purpose of this investigation was to (1) adapt wet-process autoradiography to metallurgical studies, (2) evaluate and improve the process, and (3) obtain metallurgical information using this high resolution autoradiographic method.

Wet-process autoradiography involves the preparation of a collodion film on the surface of a radioactive metallographic sample. The collodion film contains soluble halides which form silver halides when immersed in a silver nitrate solution. The insoluble silver halide, held in place by the collodion film, is subject to ionization by the radiation from the metal sample. Following the exposure, the radiation affected silver bromide in the collodion emulsion is photographically developed and fixed. The developed silver grains are located directly over the radioactive region.

Physical development is used with the wet collodion process. The developing solution must contain silver ions as well as a reducing agent. The silver of the photographic latent image nucleates the reduction of the silver ions in solution. It is possible to control the developed silver grain size by varying the time and temperature of development and by changing the composition of the developer. The developed silver grains are frequently about one micron in diameter.

Since the photographic chemicals must be kept from contacting the metal specimen, it was necessary to develop suitable protective layers. Gold and silver vacuum evaporated films and many plastic materials were investigated. For high resolution autoradiography, this protective layer must be very thin. The Vinylite layer recommended is less than one micron thick.

High resolution autoradiography requires the use of a thin heavily loaded detecting photographic layer in close contact with the sample surface. The thickness of the collodion "emulsion" is controlled largely by the amount of solvent used to dilute the collodion. Suitable layers, containing about 90 weight percent silver bromide, were prepared approximately 4 microns thick.

Preparation and processing of the detecting layer were the subject of close study. Sensitizers were added with the hope of improving radiation sensitivity. The temperatures of the several solutions were varied from room temperature to 2°C. Photographic background fog is minimized when the autoradiographic exposure takes place at temperatures near 2°C. A fog level of less than 1000 silver grains per square millimeter is readily achieved. This is lower by a factor of perhaps 10 or 100 than the fog level obtained with commercial emulsions.

A comparison is made of results obtained with wet-process autoradiography and with a commercial autoradiographic emulsion. The metallurgical sample requirements and detecting layer specifications are discussed in detail. The limitations applicable to autoradiography in general and the wet-process in particular are reviewed.

Under favorable conditions of suitable radiation and proper emulsion processing, a resolution of better than ten microns can be obtained with wet-process autoradiography. The autoradiograph is examined in place on the metallurgical specimen at magnifications as high as 1000X.

Standard radioactive samples were prepared including carbon-14 carburized iron and steel, nickel-63 electroplated on platinum or silver, a nickel-silver powder mixture containing nickel-63, and a copper-antimony alloy containing copper-64. A complex alloy (type N-155) containing tungsten-185 was also prepared. The tungsten distribution in this alloy was unknown. 184 pages. $2.30. MicA 55-900

HYDROXAMIC ACIDS AS ANALYTICAL REAGENTS

(Publication No. 11,672)

Warren Murray Wise, Ph.D.
Purdue University, 1955

Major Professor: Dr. Warren W. Brandt

Hydroxamic Acids as Analytical Reagents

A satisfactory general method for preparing aliphatic and aromatic hydroxamic acids is described. The isolation of the desired compound is accomplished by hydrolyzing the potassium salt with an acid charged cation exchange resin in methyl alcohol. Removal of the excess solvent and recrystallization of the residue from ethyl acetate effect purification. The ionization constants of some of the prepared

compounds did not agree with the values given in the literature. Conductance data had been utilized to find the ionization constant of benzohydroxamic acid, and it was shown that for extremely weak acids the K_a's calculated from potentiometric measurements are more reliable than those found from conductance data.

An Investigation of the Vanadium(V)-Hydroxamic Acid Systems

This study was conducted for the purpose of gaining information pertaining to the chemistry of the reaction occurring between vanadium(V) and the hydroxamic acids. It was found that the aromatic compounds are the more sensitive reagents for vanadium(V) than the aliphatic. The formation constants of the complexes formed in aqueous solution between vanadium(V) and benzohydroxamic acid were obtained. Since it was observed that some oxygenated organic solvents can extract the complex formed at pH 2.0, a study was undertaken in order to find the solvent producing the most sensitive system for spectrophotometric measurements. Alcohols appear to be the best extractants for the purpose. The chelates formed between vanadium(V) and the other hydroxamic acids were also investigated.

The Spectrophotometric Determination of Vanadium(V) with Benzohydroxamic Acid and 1-Hexanol

A method for determining minute accounts of vanadium was developed. It is based on the extraction with 1-hexanol of the vanadium(V)-benzohydroxamic acid complex formed at pH 2.0. The effects of the following variables were investigated: the kind of alcohol used for the extraction, amount of reagent, pH, ionic strength, volume of the aqueous phase, and diverse ions. The system obeys Beer's law between the limits of 5.00×10^{-7} and 1.00×10^{-5} mole of vanadium(V). The method is accurate, reproducible, sensitive, and precise. After removing iron(III) the procedure can be used satisfactorily for determining minute amounts of vanadium in steels, alloys, and crude oils. 129 pages. $1.61. MicA 55-901

CHEMISTRY, ANALYTICAL

I. EXACT CRYSTALLOGRAPHIC ORIENTATION STUDIES WITH WEISSENBERG AND PRECESSION GONIOMETERS. II. APPLICATIONS OF GONIOMETRIC ANALYSES TO THE CRYSTAL STRUCTURE DETERMINATIONS OF HYDRAZINOSULFURIC ACID, BARIUM HYDRAZINOSULFATE MONOHYDRATE, DIPHENYL PHTHALATE, DEHYDROQUINOLIZIDINE PERCHLORATE AND 8-HYDROXYQUINOLINE.

(Publication No. 11,546)

Walter Eugene Thatcher, Ph.D.
University of Illinois, 1955

The crystal structures of five different compounds have been determined by using the x-ray techniques described in Part I. No x-ray work has been done on any of these compounds before. A brief outline on the results of the investigations for each of the compounds follows:

Hydrazinosulfuric acid, NH_2NHSO_3H, is orthorhombic with $a_0 = 4.85$, $b_0 = 8.40$, $c_0 = 8.57$A, $n = 4$, $d = 2.139$ and $\rho = 2.136$. Space group is Pbcm - D2h (11). The hydrazinosulfuric acid molecule is very similar to sulfamic acid in both physical and chemical properties. This analogy carries over into the x-ray data where it is calculated that by doubling the hydrazinosulfuric acid unit cell along the a-axis, the resulting cell would be just enough larger than the sulfamic acid unit cell so as to accomodate the -NH- group. Then these acids would occupy similar positions with corresponding symmetry elements in their respective unit cells.

Barium hydrazinosulfate monohydrate, $Ba(NH_2NHSO_3)_2 \cdot H_2O$, is monoclinic with $a_0 = 14.41$, $b_0 = 8.57$, $c_0 = 15.02$A, $\beta = 93^0 13'$, $n = 14$, $d = 4.713$ and $\rho = 4.747$. Space group is $P2_1/m$ - C2h (2). This is the second known case in which 14 molecules per unit cell have been found, the other case being for tetragonal $K_3TlCl_6 \cdot 2H_2O$. The symmetry of the space group points out the peculiar complexity of the arrangement for these molecules by requiring three and one-half molecules to assume each of the four asymmetrical positions in the unit cell.

Diphenyl phthalate, $C_6H_4(COOC_6H_5)_2$, is monoclinic with $a_0 = 8.76$, $b_0 = 12.59$, $c_0 = 14.33$A, $\beta = 98.4^0$, $n = 4$, $d = 1.313$ and $\rho = 1.361$. Space group is $P2_1/c$ - C2h (5). It is shown by x-ray studies that the three aromatic nuclei are parallel, with the two phenyl groups lying in the same plane below the plane of the benzene-acid group. These molecules have an intermolecular distance of about 3.8A as determined from the trial structure.

Dehydroquinolizidine perchlorate, $[C_9H_{16}N]ClO_4$, is orthorhombic with $a_0 = 710$, $b_0 = 12.08$, $c_0 = 13.62$A, $n = 4$, $d = 1.347$ and $\rho = 1.354$. Space group is $P2_12_12_1$ - D2 (4). The organic group is shown to be planar with this plane lying in the a-c plane of the "flake" crystals. The molecules pack in the b-axial direction with the perchlorate ions lying near the symmetry elements (screw axes).

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

8-Hydroxyquinoline, 8-C_9H_6NOH, is triclinic Pl - Cl (1), pseudoorthorhombic with $a_0 = 3.80$, $b_0 = 25.03$, $c_0 = 28.68$A, n = 16, d = 1.439 and $\rho = 1.415$. Space group is Fdd2 - C2v (19). This compound has a crystalline structure such that 16 molecules are packed flat-wise into a unit cell of 3.8 x 25.0 x 28.7 A dimensions. These units then grow into needles in a direction perpendicular to the plates. Because of its anomalous twinning, 8-hydroxyquinoline can only be classified in the lowest symmetry space group Pl - Cl (1). 152 pages. $1.90. MicA 55-902

CHEMISTRY, BIOLOGICAL

SOME PROPERTIES OF PHOSPHOTARTARIC ACID

(Publication No. 11,861)

Henry Robert Bungay, III, Ph.D.
Syracuse University, 1954

Phosphotartaric acid has biological significance because it is an intermediate by which tartaric acid might be converted to phosphoglyceric acid or to a four-carbon acid of the Kreb's tricarboxylic acid cycle. Previous work in this laboratory[1] on the metabolism of tartarates by the mold Aspergillus niger disclosed phosphoglyceric acids in the final culture media; the proposed metabolic pathway was phosphorylation and decarboxylation of tartaric acid. In the experiments reported here, L-(+)- phosphotartaric acid was synthesized and studied in aqueous solution to gain insight into its possible biochemical behavior. To support the feasibility of an enzymatic decarboxylation and in hope of finding a system suitable for the study of complexes of metal ions with phosphate esters, an attempt was made to demonstrate thermal decarboxylation of phosphotartaric acid. When the amount of decarboxylation was found to be slight and within the limit of experimental error, attention was turned to an inspection of phosphorylating pathways in tartarate metabolism and to a detailed study of phosphotartarate hydrolysis.

To plan for decarboxylation experiments, information about the ionization characteristics and hydrolytic stability of phosphotartaric acid was desirable. Prior to knowledge of the work of another group,[2] the ionization constants were estimated from pH titration curves. Discrepancies between the observed and literature values of pK were discussed, and the results were compared to the pK values of related compounds.

Preliminary measurements of the hydrolysis rate of phosphotartaric acid were performed to find a temperature at which the material was sufficiently stable to permit decarboxylation studies. The preparation was moderately stable at 80° which was the maximum temperature at which routine manometric manipulations were practical. More accurate determinations of the first order rate constants for use in plotting rate versus pH indicated that the preparation was considerably less stable than that of other investigators.[2] A phosphotartarate solution similar in hydrolytic stability to those reported in the literature was prepared by conversion of the barium salt to the lead salt, removal of lead with hydrogen sulfide, and treatment with IR-4-B anion-exchange resin activated with concentrated hydrochloric acid. The shapes of the plots of first order hydrolysis rate constant versus pH were quite different for the original material and the purified solution. A four-fold increase in rate was noted when traces of quinoline were added to the purified solution, and it was felt that quinoline incompletely removed from the initial preparatory reaction mixture was responsible for the instability of the original material. An attempt was made to relate the rate profile curves to possible hydrolysis mechanisms derived by analogy to the shapes of pH-rate profiles of other esters.

Estimation of carbon dioxide liberated from solutions of the original preparation at 80° showed less than 0.1 per cent decarboxylation in 14 hours. Metal ion catalysis experiments were hindered by the insolubility of phosphotartarates, and only a slight increase in evolved gas was noted. The small apparent evolution of gas did not permit a conclusion about the existance of a decarboxylation of phosphotartaric acid.

The measured specific rotation of phosphotartarate in the presence of molybdate agreed with the determination reported in the literature.[2]

Using a paper chromatographic technique for phosphate esters, faint spots indicative of phosphoglyceric acids were obtained with cultures of A. niger on tartarates. Even with attempts at inhibition of phosphoglycerate dissimilation, no organic phosphates could be isolated from the culture media. The isolations reported previously[1] could not be duplicated, thus the metabolic pathway for tartaric acid is still subject to doubt. Poor controls negated experiments with bacterial cultures.

3-By spectrophotometric measurements phosphoglyceric acid was found to complex with ferric and cobaltous ions but not cupric ions. The strengths of the complexes was insufficient for a detailed investigation. 115 pages. $1.44. MicA 55-903

1. Weiss, T. J., Thesis, Syracuse University, (1953).

2. Lynen, F., and Bayer, H., Ber., 85, 905 (1952).

A CHEMICAL STUDY OF THE NUTRITIVE COMPOSITION OF THE WOOD-ROTTING FUNGI, POLYPORUS PALUSTRIS AND DAEDALEA QUERCINA

(Publication No. 11,866)

Maurice S. Fagan, Ph.D.
Syracuse University, 1955

The main objectives of this study were the determination of the chemical composition of the mycelium of the wood-rotting Basidiomycetes, Polyporus palustris and Daedalea quercina and the effects of the medium constituents on the composition. Preliminary studies determined the effects of different submerged culture methods (shake and forced aeration) on mycelial propagation.

The amounts of growth by the two submerged culture methods were compared in a one per cent malt extract solution, using a standardized inoculum. About 1000 ml. of air per minute per liter of medium, forced through a stainless steel aeration head containing four holes 1/16 inch in diameter and one inch apart, gave the greatest production of mycelium. This method was adopted as standard throughout the investigation. The forced aeration method produced more growth of both organisms than did shake cultures with four of six media tested.

Mycelium of both organisms was grown in quantity in six different media incubated at 28° C. for seven days. Three media were synthetic and quantitatively optimal for each organism: they differed qualitatively only in their nitrogen sources, namely glutamix acid, urea and ammonium nitrate. Three non-synthetic media were employed: "Curbay BG-80," spent brewers' grain and malt extract. In general, the non-synthetic media supported more growth than the synthetic media.

The total nitrogen, fat, fiber and mineral content of the mycelium produced in the six media were determined by standard methods. In the synthetic media, the type of nitrogen influenced the amount of growth and of protein synthesized by both organisms. The protein content (nitrogen x 6.25) of P. palustris mycelium ranged between 35.0 and 41.9 per cent (dry basis), while that of D. quercina mycelium varied from 29.4 to 35.0 per cent, depending upon the medium.

The amino acids of the mycelial protein from the six media were determined qualitatively by two-dimensional paper chromatography. The type of medium did not influence the number or kinds of amino acids synthesized by either organism. P. palustris synthesized 17 amino acids: the ten considered essential in animal nutrition -- lysine, tryptophane, histidine, phenylalanine, valine, leucine, isoleucine, threonine, arginine and methionine -- plus alanine, aspartic acid, glutamic acid, glycine, proline, serine and tyrosine. D. quercina synthesized asparagine in addition to those above.

The fat, fiber and mineral content of mycelium of both organisms were influenced by the type of medium employed.

P. palustris mycelium contained from 2.1 to 9.0 per cent of fat (dry basis), while that of D. quercina ranged from 2.6 to 7.4 per cent.

The fiber content of the mycelium of P. palustris ranged between 41.4 and 56.0 per cent; that of D. quercina varied from 44.3 to 57.2 per cent.

P. palustris mycelium ranged in phosphorus from 0.36 to 1.40 per cent, in calcium from 0.22 to 2.11 per cent, and in iron from 0.01 to 0.19 per cent. D. quercina mycelium ranged in phosphorus from 0.60 to 1.35 per cent, in calcium from 0.34 to 14.98 per cent, and in iron from 0.02 to 0.05 per cent.

Compared with standard commercial animal rations, basic animal feed supplements and constituents, the fungal mycelium contained a higher percentage of protein, fat and nutritionally important minerals. 94 pages. $1.18. MicA 55-904

UTILIZATION OF D-GLUCOSE-1-C^{14} BY TORULA UTILIS YEAST

(Publication No. 11,559)

Sam Frankel, Ph.D.
Washington University, 1955

Chairman: Dr. John C. Sowden

Torula utilis yeast was grown aerobically in a synthetic medium containing D-glucose-1-C^{14} (75 counts per minute per micromole) as the sole source of carbon to obtain information concerning the dissimilation of D-glucose for the biosynthesis of various yeast constituents. The yeast was extracted serially with alcohol:ether to remove lipides, cold water for the water-soluble mannan, 2.2 per cent cold sodium hydroxide for nucleic acids, 6 per cent cold sodium hydroxide for polysaccharides other than glycogen, and 30 per cent hot potassium hydroxide for glycogen.

Crystalline D-mannose was isolated from the water-soluble mannan after acid hydrolysis, conversion to the phenylhydrazone, and reconversion to the sugar using benzaldehyde. This sample of D-mannose was found to be completely devoid of radioactivity.

Nucleic acid was degraded into its constituents by hydrolysis with either sodium hydroxide, hydrochloric acid, or perchloric acid, and the constituents were subsequently separated by paper chromatography. The D-ribose showed a relatively low content of isotope, having an average specific activity of 7 counts per minute per micromole. The specific activities, in counts per minute per micromole, of the various purine and pyrimidine components were 31 for adenylic acid, 28 for guanylic acid, 44 for cytidylic acid, and 35 for uridylic acid. The values for the free bases were only slightly less except for that of cytosine which was the same as that for cytidylic acid.

In the 6 per cent sodium hydroxide extract there was obtained a second mannan sample yielding, after the same treatment as used for the water-soluble sample, a crystalline D-mannose having a specific activity of 54 counts per minute per micromole. The

amount of radioactivity at carbon-1 was determined by conversion of D-mannose to D-mannonic acid, condensation with o-phenylenediamine to yield D-mannobenzimidazole, oxidation to benzimidazole carboxylic acid, and decarboxylation to benzimidazole. The benzimidazole obtained, which contained carbon-1 of the D-mannose, had a specific activity of 48 counts per minute per micromole.

The glycogen fraction yielded, after acid hydrolysis, both D-glucose and D-mannose. Several reprecipitations of the polysaccharide(s) with alcohol or glacial acetic acid failed to reduce, after acid hydrolysis, the relative concentration of D-mannose determined visually following paper chromatography. The D-mannose obtained after acid hydrolysis of the "glycogen fraction," was isolated as the phenylhydrazone, and subsequently converted to the phenylosazone which revealed a specific activity of 53 counts per minute per micromole. The phenylosazone of the D-glucose from the hydrolysate had a specific activity of 50 counts per minute per micromole.

The results of this experiment are interpreted as suggesting that D-glucose was dissimilated, under the conditions used, by the Embden-Meyerhof glycolytic pathway, by the oxidative shunt pathway (which appeared to be reversible), and by direct incorporation into glycogen. Also, the evidence implied that D-mannose was produced directly by isomerization from D-glucose and condensed into mannan concurrently with the incorporation of D-glucose into glycogen. Furthermore, there was present a synthesis of D-mannose by some mechanism which excluded carbon-1 of D-glucose. This D-mannose condensed into a mannan polysaccharide which had different extraction behavior than that formed by the D-mannose arising from D-glucose by isomerization.

83 pages. $1.04. MicA 55-905

SOME ASPECTS OF THE PROBLEM OF EVALUATING DENITRIFICATION IN SOILS

(Publication No. 11,507)

Roland Daniel Hauck, Ph.D.
University of Illinois, 1955

The reduction of nitrate nitrogen to gaseous forms in soils has been reported by many workers in several fields of study. In the majority of these studies, the quantity of nitrogen presumably lost through volatilization is represented by the difference in total nitrogen content at the beginning and conclusion of an experiment. The possibility exists that some of the nitrogen which is presumably lost from a soil system during incubation is in fact not lost from the system, but is changed to some form of nitrogen which is not detected by the usual analytical procedures used in this type of study. The first objective of this thesis was, therefore, to study the analytical procedures for determination of nitrogen with respect to such a possibility. The second objective was to study the recovery of all the nitrogen originally present in a soil system undergoing incubation for a given period of time. To this end, the mass spectrometer and the infra-red spectrophotometer were used to determine quantitatively the production of nitrogen (N_2) gas and nitrogen oxides, respectively, from laboratory soil containing nitrate nitrogen enriched with the heavy isotope, N^{15}. Chemical analyses of total organic and inorganic nitrogen were made to complete the nitrogen balance sheets.

Using the results of the studies on analytical procedures as criteria, the chemical methods which were used for determining soil nitrogen were considered sufficiently accurate for the purpose of working out a soil nitrogen balance sheet.

To interpret the unique distribution of isotopes which was found in the gas samples obtained from denitrifying soil cultures, a set of expressions was derived so that the mass spectrometer data obtained from the samples could be translated to amounts of N_2 gas which were evolved from the cultures.

The difficulty of interpreting the infra-red absorption pattern obtained from isotope-enriched nitrous oxide resulted in a loss of accuracy for the nitrous oxide determinations.

Quantitative estimates of N_2 and N_2O evolved from soil were considered accurate to about 1% and 5%, respectively. Denitrification was detected from nitrate nitrogen added to soils in amounts equivalent to 1000, 800, 400, 160 and 80 pounds of nitrogen per acre.

A nitrogen balance sheet was worked out for soils undergoing denitrification in which all forms of nitrogen known to be present in the systems were determined by direct measurement. About 95 to 100% of the soil nitrogen originally present was accounted for after 3 weeks incubation in a closed system.

110 pages. $1.38. MicA 55-906

EFFECTS OF CHEMOTHERAPEUTIC AGENTS ON GROWTH, URINARY PHENOLS, AND AROMATIC ACIDS

(Publication No. 11,886)

Gerald Kessler, Ph.D.
University of Maryland, 1954

Supervisor: Professor Emil G. Schmidt

Certain chemotherapeutic agents are known to stimulate growth and improve feed efficiency values of growing animals. Under our experimental conditions with growing rats, 3-nitro-4-hydroxyphenylarsonic produced a mild but inconsistent improvement upon growth and feed efficiency values. Aureomycin was only slightly beneficial as a growth promotant while kojic acid was found to be inert. When the ether-soluble, aromatic acid fraction of hydrolyzed urine was fed to growing rats, slightly toxic effects were observed.

Methods are described for the determination of urinary phenols, aromatic hydroxy acids, and total

nitrogen. The effects of certain chemotherapeutic agents on the substances which constitute these fractions were studied in detail. The various compounds under investigation were mixed with the natural lab chow in measured amounts and then fed to mature Sprague-Dawley rats (220-250 gm.). 3-Nitro-4-hydroxyphenylarsonic acid was found to be inert; whereas, aureomycin caused a reduction in the phenolic fraction---the aromatic acid fraction remaining unchanged. Streptomycin sulfate also produced a marked decrease in the urinary phenolic fraction, accompanied, however, by a corresponding increase in the aromatic acid fraction.

A microbiological assay procedure for phenyllactic, p-hydroxyphenyllactic, and indole-3-lactic acids is described. When measured amounts of these acids were added to human and to rat urine, recovery values adequate within the limits of experimental error were obtained. The concentration of phenyllactic and p-hydroxyphenyllactic acids in rat urine were determined. The amount of volatile phenols (as p-cresol), aromatic hydroxy acids (as p-hydroxyphenylacetic acid), total nitrogen, and the three individual aromatic acids were determined in the urine of five negro and five adult males. While wide variations in the concentration of these constituents in the individual urines were noted, no significant difference was observed between the urine of negro and white males. The protein content of the diet was found to have little influence upon the phenol and aromatic hydroxy acid fraction of the urines.

63 pages. $1.00. MicA 55-907

THE MECHANISM OF ACTION AND SOME PROPERTIES OF THE ENZYME HYDROGENASE

(Publication No. 11,464)

Alvin Isaac Krasna, Ph.D.
Columbia University, 1955

The enzyme hydrogenase occurs in various species of microorganisms and is presumably present whenever hydrogen gas is either utilized or produced by them. This enzyme catalyzes the reduction of many organic and inorganic compounds by molecular hydrogen. It also catalyzes the exchange reaction between hydrogen and heavy water.

$$H_2 + HDO \rightleftharpoons HD + H_2O$$

The action of this enzyme is very similar to that of platinum hydrogenation catalysts and the reducing potential of the enzyme system is the same as that of the hydrogen electrode. Inhibitor studies suggest that the enzyme is a ferrous iron-porphyrin-protein complex.

Proteus vulgaris, which has a very active hydrogenase, was the organism used in the present studies.

Both whole cells and cell-free extracts catalyze the reduction of nitrate to nitrite by a mole of molecular hydrogen. Nitrite is not further reduced even in the presence of benzyl viologen. An induction period exists which is dependent on the oxygen content of the system. Nitrate cannot be reduced until all the oxygen is removed.

Whole cells and cell-free extracts catalyze the exchange reaction between heavy water and hydrogen and the conversion of para to normal hydrogen. Both reactions follow first-order kinetics and are equally affected by the inhibitors, oxygen and cyanide. At high bacterial or extract concentration, the rate limiting step is the solution of hydrogen in water. Whereas cells, suspended in H_2O, catalyze the conversion of para to normal hydrogen, no conversion occurs if D_2O is substituted for H_2O. These experiments are all in accord with the following mechanism for the mode of action of hydrogenase:

$$H_2 + E \rightleftharpoons H{:}E^- + H^+$$

where E represents the enzyme. The hydrogen of $H{:}E^-$ is not immediately exchangeable with water. $H{:}E^-$ is the active reducing agent.

The enzyme has been shown to combine reversibly with oxygen resembling, in this respect, hemoglobin. The oxygenated enzyme is inactive. It can be activated by any process which removes oxygen. This has been done chemically by sodium hydrosulfite, enzymatically by adding glucose oxidase and glucose, and physically by degassing. Crude extracts remove oxygen by the oxyhydrogen reaction. The lag phase observed in hydrogenase preparations is the time required to deoxygenate the system.

Nitric oxide strongly inhibits hydrogenase at very low concentrations. This supports the view that hydrogenase is an iron containing enzyme.

66 pages. $1.00. MicA 55-908

THE MECHANISM OF RIBOSE AND DESOXYRIBOSE SYNTHESIS IN ESCHERICHIA COLI

(Publication No. 11,414)

Mary C. Lanning, Ph.D.
University of Pennsylvania, 1955

Supervisor: Seymour S. Cohen

The mechanism utilized for the synthesis of the nucleic acid carbohydrates has not been established for any intact biological system, although the enzymatic formation of these pentoses has been demonstrated in vitro.

Ribulose phosphate, a compound in equilibrium with ribose phosphate in the presence of pentose isomerase, may be formed from 6-phosphogluconate by oxidative decarboxylation. It may also be synthesized from smaller molecules. Thus, transketolase is able to transfer a ketol moiety from certain compounds to glyceraldehyde phosphate, resulting in ribulose phosphate formation. Also, aldolase may synthesize pentose compounds of the xylose configuration, and it has been shown that xylose may give rise to a ribose compound in microorganisms.

E. coli was grown in a synthetic medium with glucose-1-C^{14} as sole carbon source. The nucleotides

were separated from the acid-insoluble material, and the ribose dehydrated to furfural by acid treatment. The furfural was either converted to furoic acid, or isolated as the 2,4-dinitrophenylhydrazone derivative; the latter was further purified by chromatography on an alumina column. The molar specific activity of these derivatives was 20 - 30% of that of the glucose-1-C^{14} used. This value is consistent with the hypothesis that, in normal aerobically growing E. coli, the major pathway of ribose synthesis from glucose involves a splitting off of the C-1 atom of the hexose. Some synthesis from smaller molecules may also occur, but if so, this is a minor mechanism.

Desoxyribose has been synthesized enzymatically in vitro from acetaldehyde and glyceraldehyde phosphate. On the other hand, in vivo studies have been interpreted as evidence that ribonucleosides may be converted to desoxyribonucleotides.

E. coli infected with T6r bacteriophage is of interest in the study of desoxyribose synthesis because of the difference in metabolism of this system as contrasted to the normal cell. The method by which glucose is degraded differs, in that the oxidative path is used to a lesser degree, and the rate of synthesis of desoxyribonucleic acid is much greater than in the normal cell.

Desoxyribonucleic acid was isolated from normal cells grown in a glucose-1-C^{14} medium, and the desoxypentose converted to levulinic acid by acid treatment. The same derivative was obtained from purified phage liberated from cells of E. coli, which were suspended in a glucose-1-C^{14} medium during the latent period preceding lysis. In each case, the levulinic acid was isolated as the 2,4-dinitrophenylhydrazone derivative, which was purified by partition chromatography. The molar specific activity of the derivative from normal cells was 23% of that of the glucose of the medium; the same value for the derivative of the phage desoxyribonuclaic acid was 50%. These two values are consistent with the alteration in glucose metabolism of the infected cell if triose phosphate, or a compound derived from triose phosphate, is utilized in the synthesis of desoxyribose. However, this utilization need not be direct, and the hypothesis that a ribose compound is a precursor of desoxyribose is not necessarily invalidated.

52 pages. $1.00. MicA 55-909

THE EFFECT OF SULFUR DEFICIENCY ON THE NITROGEN METABOLISM OF ALFALFA

(Publication No. 11,645)

Hiromu Matsumoto, Ph.D.
Purdue University, 1955

Major Professor: Edwin T. Mertz

The general effect of sulfur deficiency on plants has been known for some time. Plants grown in a medium lacking in sulfur have a low protein and a high soluble nitrogen content. However, little is known about the amino acid and protein changes occurring within them. In alfalfa, the increase in soluble non-protein nitrogen has been shown to be due to an increase in aspartic acid and arginine content. All other amino acids decreased in plants grown in a sulfur-deficient medium. This study constitutes a more detailed examination of the changes in the nitrogen metabolism of alfalfa deprived of sulfur.

Five sets of cutting of alfalfa grown in sand culture with complete and sulfur-deficient nutrient solutions were studied. The leaf and stem were studied separately. The immediate visual effect on plants grown without sulfur was the reduced growth of the plants, which had small, stiff, somewhat chlorotic leaves with elongated stems. The aspartic acid content increased in both the leaf and the stem. The level in the stem of the fifth cutting of the plant was more than five times that found in the normal plant. Arginine in both the leaf and stem increased at least 50% over that in the normal plant. Eight other amino acids assayed in the leaf and stem decreased in content with sulfur deficiency.

The cytoplasmic and particulate proteins of normal and sulfur-deficient alfalfa leaf were compared by utilizing a procedure recently developed for the separation of these proteins in spinach and other leafy plants. The nitrogen in the control leaf was made up of 30% particulate protein, 33% cytoplasmic protein and 37% non-protein material. In sulfur deficiency, the particulate proteins were 15-30%, the cytoplasmic proteins 10-30%, and non-protein material 40-75%.

The cytoplasmic proteins were examined by means of electrophoresis. The major portion of the proteins, designated as Fraction I, travelled under a single peak. There were two minor components, one preceding (Fraction a) and one behind (Fraction b). When the relative areas of each component were calculated, Fraction I was found to comprise about 75% of the total cytoplasmic proteins. In sulfur deficiency, this fraction decreased to as low as 50% of the total cytoplasmic proteins. Fraction I was shown to be a nucleo-protein. The mobility and solubility were found to be similar to the corresponding major protein in spinach, tobacco, etc. The cytoplasmic proteins contained a larger quantity of arginine and glutamic acid than the particulate proteins. The ratios between amino acids of the sulfur-deficient cytoplasmic proteins differed from those of normal cytoplasm.

Normal alfalfa leaf particulate matter contained about 42% crude protein while sulfur-deficient leaf particulate matter contained 23-40% crude protein depending on the cutting. Particulate proteins of both normal and sulfur-deficient plants were found to be higher in methionine than the cytoplasmic proteins. The ratios of the amino acids in the particulate proteins of normal and sulfur-deficient plants were practically the same.

While in normal leaf the protein nitrogen and the non-protein nitrogen were about equal, in the sulfur-deficient leaf the non-protein nitrogen was seven times more than the protein nitrogen, in the fifth cutting. About 12.5% of the non-protein nitrogen was in

the amide form in normal leaf and 43% was in this form in the sulfur-deficient leaf. Free amino acids in the alfalfa cytoplasm were the same ones found by others who used a different extraction method. The entire increase in arginine in sulfur-deficient leaf was accounted for as free arginine.

The level of sulfate exceeded 0.5% of the dry weight of normal alfalfa leaf while in the sulfur-deficient leaf it was lower than 0.5%. The phosphate was lower in the normal than in the sulfur-deficient leaf.

The change in amino acid composition of sulfur-deficient alfalfa after the addition of sulfur to the nutrient medium was studied. The change in ratios between amino acids indicated the proteins in the alfalfa plant returned to their normal proportions and levels in five to fifteen days.

The probable metabolic changes in sulfur-deficient alfalfa suggested by these data are discussed.

92 pages. $1.15. MicA 55-910

THE EXCRETION OF PURINE BASES IN THE URINE OF NORMAL AND GOUTY SUBJECTS

(Publication No. 11,857)

Royden Nelson Rand, Ph.D.
University of Buffalo, 1955

Overproduction of uric acid has been suggested as a cause of gout. Some patients have shown increased incorporation of glycine N^{15} into uric acid, supporting this hypothesis. However, no information is available on the rate of incorporation of isotope into adenine, guanine, hypoxanthine and xanthine.

The present work reports a method for the isolation, separation, identification and quantitation of the small amounts of purines excreted in the urine of man. This study seems necessary in order to relate uric acid synthesis to purine synthesis. The study is valuable in that differences in the nature and quantities of purines excreted by the normal and gouty serve as valuable clues to the etiology of gout.

In this work, purines were precipitated from urine by cuprous ion. The precipitates were decomposed with H_2S and the acid solutions of the purine bases were separated on Dowex 50 ion exchange resin. The purines were identified by paper chromatography of the separated fractions and by ultraviolet spectrophotometry.

Five experiments were run with two normal and two gouty subjects. All abstained from the common sources of methyl purines such as coffee, tea, cola and chocolate, for seven to fourteen days prior to the collection of urine.

In the normal subjects R.R. and H.A., the following purines were found: (a) xanthine, (b) hypoxanthine, (c) 7-methyl guanine. In addition, there was guanine in urine from R.R., who excreted per twenty-four hours: xanthine-3mg., hypoxanthine-12 mg., 7-methyl guanine- 8 mg., guanine- 9 mg..

Two experiments were run on gouty subject D.F.. The following purines were excreted per twenty-four hours: xanthine-2 mg., hypoxanthine-4 mg., 7-methyl guanine- 6 mg..

With gouty subject G.S., a marked decrease in the amounts of the purine bases was noted, the only identified purines being: xanthine and a probable guanine. Hypoxanthine and 7-methyl guanine were absent.

In all the urines, other ultraviolet absorbing material was present. The nature of this is not known.

203 pages. $2.54. MicA 55-911

A STUDY OF NUCLEIC ACID FRAGMENTS OCCURRING IN MOUSE TISSUE

(Publication No. 11,573)

Donald Leroy Seaton, Ph.D.
Washington University, 1954

Chairman: Professor Joseph W. Kennedy

Utilizing the techniques of solvent extraction, paper chromatography, and absorption spectroscopy, methods have been developed (see Dorough, G. D. and Seaton, D. L., J. Am. Chem. Soc., 76, 2873 (1954) for description of these methods) for the extraction, separation, and assay of the nucleic acid fragments occurring in mouse tissues in a loosely bound or uncombined state. Briefly, these methods are as follows: a weighed sample of a tissue to be investigated is homogenized for 20 minutes at 0°C with an excess of N,N-dimethylformamide (DMF). The DMF solution is separated from the tissue residue by centrifugation and evaporated to dryness under vacuum. The solid material remaining from the evaporation contains nucleoside polyphosphates, nucleotides, nucleosides, purines, pyrimidines, amino acids, fatty material, and unknown compounds. After a purification step to remove fatty material, the extracted compounds are separated by the technique of two dimensional paper chromatography, using three solvents, however, in place of the usual two. The individual spots on the paper chromatogram (detected under ultraviolet light) are identified by reference to the behavior of known substances when chromatographed in an identical way, and by a comparison of the ultraviolet absorption spectra of eluates of the spots in acidic and basic media with the corresponding spectra of known compounds. The amount of a particular compound extracted from the tissue may be calculated from the optical density of the compound's eluate from a paper chromatogram and certain other information.

These methods were employed first in a survey study in which the nucleic acid fragment composition of nine normal and four malignant mouse tissues was investigated. Each of these tissues was examined before any autolysis had taken place, and also after the tissue had been allowed to autolyze at room temperature for a period of four hours. The results of this survey showed that while the nucleic acid fragment patterns of the nine normal tissues show

considerable variation, the patterns of the four malignant tissues are quite similar. The patterns of the malignant tissues resemble the pattern in liver more than that of any other normal tissue.

The survey also provided certain information concerning the catabolism of nucleic acids which prompted a series of detailed autolysis studies on liver and hepatoma. In these studies the tissues were allowed to autolyze at 39°C in the presence of known amounts of nucleoside phosphates. Samples were removed from the autolyzing tissues after given periods of time and assayed for nucleic acid fragments. The results of these experiments were compared with the results obtained from control experiments in which duplicate samples of tissue were permitted to autolyze the same periods of time in the absence of added substrates. Those compounds appearing in increased amounts in the added substrate experiments as compared to the control experiments were interpreted as arising from the substrate during the autolysis. These detailed autolysis experiments provided information on the catobolic pathways available to adenylic, guanylic, cytidylic, and uridylic acids arising from the degradation of ribonucleic acid, and also revealed certain differences between hepatoma and its tissue of origin, liver. For example, when uridine-3′- or -5′-phosphate is added to autolyzing liver a large increase in the amount of uridine isolated is observed, but no increase in the amount of uracil. On the other hand, when the uridine phosphates are added to hepatoma increases in the amounts of both uridine and uracil are observed, indicating that the cleavage of uridine is much more readily accomplished in hepatoma. Further, hepatoma is able to degrade cytidine-3′-phosphate readily with the concomitant appearance of an increased amount of uridine; liver is very inefficient in degrading cytodine-3′-phosphate. Aside from these differences the autolytic pathways involving nucleic acid fragments seem to be quite similar in the two tissues with respect to the compounds which act as intermediates. There are, however, definite indications that the relative rates of reaction for some of the steps in the pathways are different.

96 pages. $1.20. MicA 55-912

THERMAL DIFFUSION OF LIPIDS AND OTHER BIOCHEMICAL SUBSTANCES

(Publication No. 11,659)

Charles William Seelbach, Ph.D.
Purdue University, 1955

Major Professor: Forrest W. Quackenbush

With the development of the counter-current convection thermal diffusion column in recent years a number of unique and otherwise difficult separations of liquid mixtures, especially mixtures of hydrocarbons, have been accomplished. These results which include a few scattered reports on materials of interest to the biochemist have indicated that thermal diffusion should be evaluated further as an additional separation method in biochemistry where the separation of complex mixtures has always been a primary problem.

Selected mixtures of fatty acids, esters, alcohols, amines, nitriles, phenols, aromatic amines, hydrocarbons and chlorinated hydrocarbons and solutions of polysaccharides, proteins and amino acids were subjected to thermal diffusion in order to determine empirically the principles of separation in terms of the structural features of the molecules. Then typical mixtures of derivatives of triglyceride oil and crude vegetable and marine oils were investigated and finally the thermal diffusion mobility of some natural isoprenoid compounds including carotenoids, squalene, phytol and terpene oils was studied in more detail.

In two thermal diffusion columns four and six feet tall, practical separations were obtained with the following mixtures of substances differing in molecular weight: homologous fatty acids, monomer and dimer unsaturated fatty acids, dibasic acid esters, primary and secondary amines, aromatic heterocyclic amines, aromatic coal tar hydrocarbons and chlorinated aromatic hydrocarbons. Also polysaccharides were concentrated in aqueous solution. In addition, several separations were accomplished in the absence of molecular weight differences or in opposition to molecular weight relationships, apparently due to differences in functional groups or molecular shapes. These mixtures included mono- and di- or tri- esters of polyols, polyoxyethylene sorbitol esters of resin and fatty acids, fatty acids and polyol esters, mono- and di-carboxylic acids, alicyclic and aliphatic alcohols, alkyl amines and hydrocarbons and phenols and aromatic hydrocarbons.

Associative functional groups, particularly groups capable of hydrogen bonding, apparently prevented or retarded separations of associative molecular types (i.e. primary amines and alcohols), but promoted the separation of associative from non-associative molecular types, in which case the associative type molecules generally concentrated toward the bottom of the column.

A crude preparation of the methyl esters of soybean oils, mixed soybean oil esters resulting from partial methanolysis, and crude mono-, di-, tri-oleate mixtures were fractionated. An excellent rectification of the soybean oil methyl esters was obtained and the methyl esters separated from the glycerides in the partial methanolysis mixture. Glyceryl trioleate separated from a glyceryl dioleate- glyceryl monooleate mixture and free glycerol was concentrated relative to the glycerides, but glyceryl monooleate did not separate from glyceryl dioleate.

The trace components of the crude triglyceride oils, particularly the pigments, concentrated toward the bottom of the thermal diffusion column. Spectrophotometric analysis of fractions gave evidence for the concentration of carotenoid, isoflavone, porphyrin, anthocyanin, gossypol and sesamin type pigments in the bottom fractions while the top fractions showed general color improvement throughout the visible

spectrum. In fact, color improvement in the overhead fractions, observed in most of the systems studied, indicated that thermal diffusion is an excellent physical bleaching method for a wide variety of chemical mixtures.

The carotenoids concentrated exponentially toward the bottom of the column, but isomerization occurred at the experimental conditions used. Partial purification of squalene and phytol concentrates was realized and an excellent separation of the terpene hydrocarbons from the terpineols was obtained.

Thus the wide variety of chemical mixtures which has been fractionated in the liquid thermal diffusion column indicates the potential usefulness of this relatively new tool as a research, analytical and industrial separation method. The fractionations of mixtures of high molecular weight and viscous materials are particularly noteworthy since these materials are difficult to separate by other conventional methods.

117 pages. $1.46. MicA 55-913

$CH_3OH \cdot B(PH_2)_3$. Thermal decomposition and analysis seem to indicate this composition.

Method (2) applied to boron trichloride resulted in a mixture of salts, confirmed by conductance measurements in liquid sulphur dioxide, which are believed to be formed according to the following set of equations:

1. $NaPH_2 + BCl_3 \longrightarrow Na[BCl_3PH_2]$
2. $2Na[BCl_3PH_2] \longrightarrow Na[BCl_2(PH_2)_2] + NaBCl_4$
3. $Na[BCl_2(PH_2)_2] + Na[BCl_3PH_2] \xrightarrow{\text{slow}} Na[BCl(PH_2)_3] + NaBCl_4$
4. $NaBCl_4 \longrightarrow NaCl + BCl_3$

The salts are rather chemically inert and are not appreciably affected by high temperatures.

The paper also discusses the polymer bondings and the mechanism involved in method (1). Various reactions are also reported between boron trichloride and ammonia at -80°C and sodium chloride and boron trichloride in liquid sulphur dioxide.

70 pages. $1.00. MicA 55-914

CHEMISTRY, INORGANIC

THE SYNTHESIS AND CHEMICAL PROPERTIES OF CERTAIN PHOSPHINOBORANES

(Publication No. 11,406)

David Milton Gardner, Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. E. C. Evers

This study deals with the preparation and chemical properties of the phosphinoboranes derived from boron trichloride, bibutylboron chloride, and butylboron dichloride.

The syntheses were effected by the two following methods: (1) by the action of phosphine gas on the appropriate boron chloride-triethylamine complex suspended in benzene which resulted in the elimination of triethylammonium chloride and a solution of the desired phosphinoborane and (2) by the action of sodium dihydrogen phosphide on the appropriate boron chloride dissolved in liquid sulphur dioxide which resulted in the elimination of sodium chloride and a solution of the phosphinoborane.

Phosphinodibutylborane and diphosphinobutylborane, formed in excellent yields by both of the above methods, are rather inert chemically although they undergo slow air oxidation. Cryoscopic measurements taken on benzene solutions of the compounds indicate that phosphinodibutylborane exists principally as the dimer and that the diphosphinobutylborane is a mixture of high molecular weight polymers.

Method (1) applied to boron trichloride is believed to have resulted in the formation of the weakly polymeric compound of the formula $B(PH_2)_3$ which was presumably isolated as the methanol adduct

STUDIES OF THE BORON HALIDES AND THEIR ADDITION COMPOUNDS IN NON-AQUEOUS SYSTEMS

(Publication No. 11,412)

Malcolm C. Henry, Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. J. F. Hazel

The properties of the boron halides were investigated. Special attention was given to the study of boron tribromide. A major phase of the investigation involved attempts to reduce boron containing compounds in non-aqueous media. Other studies dealt with preparation, composition and properties of addition compounds of boron tribromide. Analytical methods for analysis of these addition compounds were developed. Conductometric titrations in non-aqueous media were carried out in connection with the analytical problems. Ion exchange resins also were used as analytical tools. Use of boron tribromide as a catalyst in organic reactions was investigated.

Preliminary conductance measurements were made in the presence of boron tribromide with and without auxiliary electrolytes. Certain of these systems were selected for electrolyses. Special apparatus was used to exclude moisture contamination.

Results are presented for the electrodeposition, in various non-aqueous media, of aluminum, lithium, potassium and iron. Elemental boron was not detected in any of the electrodepositions under the conditions investigated. Several new addition compounds were prepared containing boron tribromide and organic bases. The organic molecules used included

pyrrole, isoquinoline, 5-nitroquinoline, morpholine, piperidine, 2-picoline, 3-picoline, 4-picoline, cyclohexanone and acridine. The compounds prepared were, with the exception of the acridine complex, white or light tan colored, crystalline compounds with high salt like melting points. The acridine addition compound was a brilliant yellow amorphous powder. Non-aqueous titrations were successfully carried out in various inorganic and organic solvents. Boron tribromide was used both as a titrant and a titratable compound. Results indicated one to one molar ratios of boron halide to organic base. Boron tribromide was shown to be a mild catalyst in organic reactions. Friedal Crafts reactions, polymerization and rearrangement reactions were used as the bases of catalytic activity. The infrared spectra of pure boron tribromide was determined.

Boron compounds were found to be of such covalent nature as to make reduction to elemental boron impossible under the experimental conditions investigated. Boron tribromide gave indications of being useful as a mild catalyst in organic reactions. Little degradation of reagents, few side reactions and relatively mild activity are cited as offering advantages in organic synthesis under certain conditions. Non-aqueous titrations showed various new addition compounds of boron tribromide to be generally of a one to one molar ratio of boron tribromide and Lewis base. The addition compound of boron tribromide and acridine and that between boron tribromide and isoquinoline when the latter was in excess, were anomalous remaining as yet not fully understood. The reactions mentioned above deserve further study.

152 pages. $1.90. MicA 55-915

THE FORMATION AND DISSOCIATION OF TRICHLOROGERMANE AND GERMANOUS CHLORIDE

(Publication No. 11,424)

Charles Wesley Moulton, Ph.D.
University of Pennsylvania, 1955

Supervisor: John G. Miller

A number of alternative procedures for preparation of trichlorogermane were investigated, and of these the most convenient was found to involve reaction of hydrogen chloride with germanous sulfide. Attempts to distil or extract trichlorogermane from strongly acid aqueous solution were unsuccessful. Trichlorogermane exhibits an appreciable instability toward dissociation into germanous chloride and hydrogen chloride. It was found possible to prepare an apparently amorphous form of germanous chloride in small quantities by distillation of trichlorogermane below room temperature. Germanous chloride decomposes at room temperature into highly colored, nonstoichiometric subchlorides. These materials were also produced in distillations at room temperature of trichlorogermane and of a mixture of trichlorogermane and diethyl ether. Thermal treatment indicated continuous decomposition through a series of lower chlorides of germanium. These subchlorides are evidently mixtures of polymeric materials. 67 pages. $1.00. MicA 55-916

THE SYNTHESIS OF HYDRAZINE DERIVATIVES: I. STABILITY OF MONOCHLORAMINE. II. REDUCTION OF DIALKYL NITROSAMINES. III. REACTION OF MONOCHLORAMINE WITH SECONDARY AMINES

(Publication No. 11,531)

Richard Anthony Rowe, Ph.D.
University of Illinois, 1955

The Raschig synthesis of hydrazine, which entails the reaction of monochloramine with large excesses of ammonia at temperatures above 60°, has been modified to produce N,N-dialkyl substituted hydrazines. Monochloramine, produced by the interaction of hypochlorite and excess ammonia at 0°, will react with various secondary amines in the cold to form the corresponding N,N-dialkyl hydrazines.

The success of this modification greatly depends upon the yield and initial concentration of the unstable starting material monochloramine. In connection with increasing the initial yield of this substance, its decomposition has been studied in alkaline solution at 0°. By following the disappearance of monochloramine iodometrically, it has been found that: (a) In the presence of an excess of ammonia, the reaction of hypochlorite with ammonia will produce a solution which is initially higher in its monochloramine concentration, but which decomposes at a faster rate than one in which the stoichiometric amount of ammonia is used. (b) The stability and initial concentration of monochloramine formed by the reaction of sodium hypochlorite and ammonia decreases with increasing concentrations of sodium hydroxide in the solution. (c) The addition of gelatine in concentrations of 0.5 g./liter will increase the stability and initial concentration of monochloramine when an excess of ammonia is present.

It was verified in the synthesis of dimethyl-, diethyl-, di-n-propyl-, di-n-butyl-, and di-n-amylhydrazine that an ammonia/hypochlorite mole ratio of 3/1 produces the highest yields of disubstituted hydrazines. Maximum isolatable yields of 20-50 per cent are approached when a 4/1 amine/hypochlorite mole ratio is employed, but the presence of an inhibitor such as gelatine has no noticeable beneficial effect.

For purposes of comparison, N,N-disubstituted hydrazines were prepared from the corresponding nitrosamines, RRNNO, by employing the following agents: (a) lithium aluminum hydride in ether, (b) sodium in alcohol and (c) sodium in liquid ammonia in the presence of a substance which acts as an acid in ammonia. The following hydrazines have been prepared where RR = $(C_2H_5)_2$-, $(n\text{-}C_3H_7)_2$-, $(iso\text{-}C_3H_7)_2$-, $(n\text{-}C_4H_9)_2$-, $(iso\text{-}C_4H_9)_2$-, $(n\text{-}C_5H_{11})_2$-,

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(-$CH_2(CH_2)_3CH_2$-) (piperidyl), (CH_3)(C_6H_5)-, and (-$CH_2CH_2OCH_2CH_2$-) (morpholyl). Identifying derivatives have been prepared in the form of the oxalate salts, 1,1-disubstituted semicarbazides, or the N-dialkylaminourethane. A suitable iodimetric procedure for the analysis of the N,N-disubstituted hydrazines or their salts has been developed.

109 pages. $1.36. MicA 55-917

THE LOWER HYDRIDES OF PHOSPHORUS

(Publication No. 11,439)

Evan Hoskins Street, Jr., Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. E. Charles Evers

Quantitative investigation of the reaction of white phosphorus dissolved in toluene with various alkali metals dissolved in liquid ammonia was conducted. Compound formation was noted by the color change from deep blue to amber at the molar compositions Li_2P, Na_2P, and K_3P_2. The compounds Li_2P and Na_2P were shown to be related to the hydride of phosphorus H_4P_2, namely biphosphine. Reduction of the compounds Li_4P_2 and Na_4P_2 to $LiPH_2$ and $NaPH_2$ respectively was found to be possible on adding four moles of ammonium bromide to a solution containing one mole of Li_4P_2 or Na_4P_2 and two moles of excess alkali metal. The presence of the dihydrophosphide ion was then detected by either conversion to phosphine with ammonium bromide or conversion to methylphosphine on the addition of methyl iodide. A mechanism for this reaction was proposed involving the intermediate production of biphosphine. To check the mechanism, pure biphosphine was prepared and its decomposition both in the presence of liquid ammonia and in the presence of liquid ammonia containing free alkali metal was studied quantitatively. The results confirmed the postulated reduction mechanism.

75 pages. $1.00. MicA 55-918

THE DETERMINATION OF RATE CONSTANTS FOR REDUCTION PROCESSES AT A STREAMING MERCURY ELECTRODE

(Publication No. 11,369)

John Richard Weaver, Ph.D.
University of Michigan, 1954

Because of the high activation energy frequently associated with processes involving coordination compounds, particularly those of the penetration type, the chemistry of these substances depends not so much on their thermodynamic properties, as on their kinetic properties. In view of the paucity of quantitative information in this area, it seemed desirable to seek out additional methods for studying the kinetics of reactions involving these compounds.

This research was directed toward the development of procedures for evaluating rate constants and transfer coefficients governing electrochemical reductions at a streaming mercury electrode. Two essentially independent methods, one a direct current method and one an oscillographic method, were worked out.

Much of this investigation was concerned with elucidating the physical properties of the mercury stream. Measurements were taken of stream diameters and stream lengths (obtained photographically), flow rates, solution flow, and size and shape of tail cones. The effects on these properties of varying the nature of the capillary, the mercury head, the distance from the orifice, and the electrode potential were studied, and used to develop the general pattern of stream and solution flow.

Direct current measurements were obtained for solutions of KCl and KNO_3 at several concentrations, varying the electrode potential, mercury head, stream length in the solution, and nature of the capillary. These measurements were used to calculate the surface velocity of the stream. The results were in harmony with the pattern of stream flow and with accepted theories of the nature of the electric double layer.

Theoretical treatments for reversible and irreversible reduction at a constant cell potential (direct current method), and at a rapidly rising cell potential with approximately constant cell current (oscillographic method) were worked out. It was shown experimentally (from diffusion current measurements) for a number of streams that the motion of the mercury and solution near the stream surface is sufficiently uniform so that the diffusion process takes place, to a first approximation, as at a stationary surface. Deviations from this behavior caused by variations in stream radius and surface velocity, curvature of the electrode surface, velocity differences in the diffusion layers, diffusion in the axial direction, variation in electrode potential due to variable IR drop, and variation in effective stream length due to reduction in the tail cone were discussed quantitatively. Verifications of the theory were made for the reduction of Cd^{++}, Tl^{+}, and Pb^{++} (all of which occur reversibly) with KCl as inert electrolyte, by showing that the corrected reduction currents varied as predicted with changing potential, stream length, and concentration.

Zn^{++}, which is reduced irreversibly at the streaming electrode, was studied by both methods. Values of the rate constant for the reduction, and transfer coefficients for the forward and reverse processes were obtained. The results were consistent for the two methods.

Equations were developed for reversible and irreversible reduction by a small alternating potential superimposed on a constant potential, not necessarily at equilibrium. 218 pages. $2.73. MicA 55-919

CHEMISTRY, ORGANIC

I. FUROXANS FROM METHYL KETONES. II. REDUCTIVE DIMERIZATION AND POLYMERIZATION OF UNSATURATED AMIDES AND NITRILES.

(Publication No. 11,490)

Nikodems Elijs Bojars, Ph.D.
University of Illinois, 1955

PART I

A mechanism for the reaction of methyl aryl ketones with nitric acid leading to diaroylfuroxans as the final products has been proposed recently.[1] According to this mechanism, advanced by Alexander and coworkers, the first step of the reaction is a nitrosation of the methyl group of the ketone; the nitroso- or oximinomethyl ketone is oxidized by nitric acid to a nitromethyl ketone, which acquires a proton from the acidic medium, and the resulting positive ion forms the furoxan.[1]

The observation made in the present work that all methyl aryl ketones which were tried could be converted to the corresponding diaroylfuroxans by treatment with excess of about 20% aqueous nitric acid in acetic acid at 40 to 60° for about 30 minutes, with the addition of a catalytic amount of sodium nitrite to start the reaction, was in agreement with the proposal[1] that nitrosation is the first step of the reaction of methyl ketones with nitric acid. However, the facility of this standard method of conversion in aqueous medium did not appear to confirm the postulate[1] that ω-nitroacetophenones are intermediates. To clarify this question, the reactions of ω-nitroacetophenone were studied with mineral acids in acetic acid as a solvent, in the presence and absence of scavengers for nitrous acid, such as urea and sulfamic acid, and of initiators, such as sodium nitrite. Either by the standard method of conversion or by concentrated, yellow nitric acid alone, dibenzoylfuroxan could be made from acetophenone in a higher yield than from ω-nitroacetophenone. Furthermore, the experiments with ω-nitroacetophenone showed that nitrosation is not only the first step of the reaction of methyl ketones but also of nitromethyl ketones with concentrated or diluted nitric acid. The presence of at least catalytic amounts of nitrous acid (or other nitrosonium ion carriers, such as N_2O_3 or NO_2) was required for the first step. In contrast, the reaction of ω-nitroacetophenone with concentrated sulfuric acid at 95° did not require an initiator such as sodium nitrite nor could it be stopped by scavengers of nitrous acid. Dibenzoylfuroxan was formed, but the reaction mixture did not develop red nitrous fumes as in the reactions with nitric acid. Diluted aqueous sulfuric acid failed entirely to react with the nitromethyl ketone.

It was concluded that the reaction of concentrated sulfuric acid with ω-nitroacetophenone proceeds by a dehydration mechanism which is not related directly to the nitrosation mechanisms; that ω-nitroacetophenone reacts with commercial, concentrated or diluted nitric acid via nitrosation, regeneration of nitrous acid by the decomposition of the nitrolic acid, and the dimerization of the resulting benzoyl nitrile oxide to dibenzoylfuroxan; and that aryl methyl ketones react with nitric acid via nitrosation, direct oxidation of the resulting aryl oximinomethyl ketone by nitric acid to aroyl nitrile oxide (with the formation of a molecule of water and the regeneration of the nitrosating agent to be used again in the first step), and the dimerization of the nitrile oxide to the corresponding diaroylfuroxan. Thus, the reaction or aryl methyl ketones with nitric acid does not appear to involve ω-nitroacetophenones as intermediates.

The standard method of conversion which gave reasonably good yields of diaroylfuroxans yielded little or no aliphatic derivatives. The use of a step-by-step procedure or a higher concentration of nitrous and nitric acids in the reaction mixture appeared to be necessary for the aliphatic class of compounds.

The reaction of the diaroylfuroxans with hydrazine produced colored azines. The reaction failed when the carbonyl groups were sterically blocked.

PART II

In conjugated unsaturated compounds such as α,β-unsaturated amides or nitriles there are two centers in the molecule where an attack by lithium aluminum hydride may occur: upon the amide or the nitrile function, and upon the carbon carbon double bond.

The reactivity of conjugated olefinic bonds in α,β-unsaturated amides was shown recently;[2] for instance, N,N-diethylcrotonamide reacted by the inverse addition procedure with lithium aluminum hydride in ether to form a bimolecular coupling product and a polymer; a small amount of an amine fraction was also isolated where the amide function had been reduced to a tertiary amine group.[2] N,N-Diethylacrylamide gave only a polyamide of a higher molecular weight in quantitative yields.[2]

In the course of the present investigation, N,N-diisopropylcrotonamide and N,N-diisopropylacrylamide were made, and their reactions with lithium aluminum hydride were studied. The isopropyl derivatives gave products similar to those obtained from the corresponding N,N-diethyl derivatives.

1-Pentene did not copolymerize when present in the reaction mixtures of the α,β-unsaturated amides with lithium aluminum hydride. In contrast, styrene copolymerized readily, although it did not react alone with the hydride at similar conditions. The nearly transparent, elastic copolymers could be drawn to sheets and fibers.

Copolymers from acrylonitrile and styrene were also produced, employing relatively small amounts of the hydride.

Reductive polymerization reactions of ethyl acrylate, methyl methacrylate, acrylonitrile, its acyclic homologs (methacrylonitrile, allyl cyanide, crotononitrile, and isocrotonitrile), and cinnamonitrile, were initiated by lithium aluminum hydride.

199 pages. $2.49. MicA 55-920

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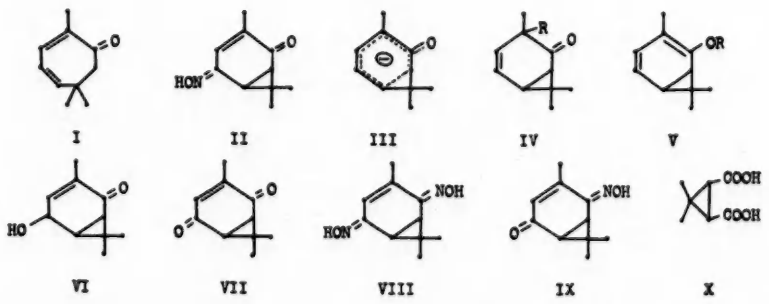
1. E. R. Alexander, M. R. Kinter, and J. D. McCollum, J. Am. Chem. Soc., 72, 801 (1950).
2. R. E. Putnam, "Reductive Coupling and Polymerization of Unsaturated Amides," Ph.D. Thesis, University of Illinois, Urbana, 1953.

I. FORMATION OF BICYCLO(4.1.0)HEPTANE DERIVATIVES FROM EUCARVONE. II. SYNTHESIS OF SOME CHLORINATED CYCLOHEXANONES.

(Publication No. 11,492)

Howard Joseph Burke, Ph.D.
University of Illinois, 1955

Eucarvone (I) has been shown to react with n-butyl nitrite in the presence of alcoholic sodium ethoxide to form the bicyclic oximinoketone II. Treatment of I with sodium amide in refluxing absolute dioxane produces sodioeucarvone, thought to be the sodium salt of the anion III. Treatment of a solution of sodioeucarvone with n-butyl nitrite, an alkyl halide, or an acyl halide results, respectively, in formation of the bicyclic oximinoketone II, a bicyclic alkyl ketone of the type IV, and a bicyclic enol ester of the type V. Treatment of I with excess selenium dioxide in refluxing absolute ethanol produces a hydroxyeucarvone VI, oxidized by manganese dioxide to the diketone VII, which is converted by hydroxylamine to the same dioxime (VIII) as is obtained from the oximinoketone II. Conversion of VI to its oxime, followed by oxidation with chromium trioxide in pyridine yields the oximinoketone IX, position-isomeric with II as shown by non-identity of the two compounds and formation of the same dioxime (VIII) from each. Structures were proved with the aid of infrared and ultraviolet spectra and oxidation or ozonolysis to the known cis-caronic acid (X). No monocyclic derivatives of eucarvone were isolated.



Part two of this work deals with the effects of α-chlorine atoms on the infrared and ultraviolet spectra of ketones. It has been shown that axial α-chlorine atoms cause a positive shift of 26-31 cm.$^{-1}$ in the infrared and ca. 11 mμ in the ultraviolet, while equatorial α-chlorine causes a positive shift of 10-18 cm.$^{-1}$ in the infrared and a slight negative shift of 2-4 mμ in the ultraviolet.

71 pages. $1.00. MicA 55-921

THE SYNTHESIS AND REACTIONS OF CERTAIN FLUORINE-CONTAINING ALKANES, CYCLOALKENES AND KETONES

(Publication No. 11,617)

Donald Harvey Campbell, Ph.D.
Purdue University, 1955

Major Professor: E. T. McBee

Part I

The p-toluenesulfonic acid esters of 2,2,2-trifluoroethanol, 2,2,3,3,3-pentafluoropropanol, and 2,2,3,3,4,4,4-heptafluorobutanol have been prepared and converted to the corresponding chlorides, bromides and iodides by reaction with the suitable potassium halide at an elevated temperature. Vapor phase chlorination of 2-bromo-1,1,1-trifluoroethanol, gave 1-bromo-1,1-dichlorotrifluoroethane. Similarly, 3-chloro-1,1,1,2,2-pentafluoropropane and 4-chloro-1,1,1,2,2,3,3-heptafluorobutane produced 3,3-dichloro-1,1,1,2,2-pentafluoropropane and 1,1,1-trichloropentafluoropropane, and 4,4-dichloro-1,1,1,2,2,-3,3-heptafluorobutane and 1,1,1-trichloroheptafluorobutane, respectively. Treatment of 1,1,1-trichloroheptafluorobutane with antimony trifluoride and antimony pentachloride gave 1,1-dichloroperfluorobutane. It was found that 4-iodo-1,1,1,2,2,3,3-heptafluorobutane and zinc reacted to yield 2,3,3,4,4,4-hexafluoro-1-butene and treatment of this olefin with chlorine gave 3,4-dichloro-1,1,1,2,2,3-hexafluorobutane.

Part II

The Aldol condensation of 1,1,1-trifluoropropanone has been studied, using as catalysts, potassium hydroxide, sodium hydroxide, sodium amide, pyridine and dimethylaniline. A 56% yield of 4-hydroxy-4-methyl-1,1,1,5,5,5-hexafluoro-2-pentanone (I) was obtained using sodium amide in chloroform at low temperature. On reaction with base (I) underwent cleavage to fluorform and the corresponding acid. Dehydration of (I) with phosphorus pentoxide gave 4-methyl-1,1,1,5,5,5-hexafluoro-3-buten-2-one which underwent addition of ammonia to form a compound presumed to be 4-amino-4-methyl-1,1,1,5,5,5-hexafluoro-2-pentanone.

Part III

The halogen exchange reaction between aluminum chloride and olefins possessing allylic fluorine atoms has been studied. 1,1,2-Trichlorotrifluoropropene and aluminum chloride reacted to form hexachloropropene. When 1,2-dichlorohexafluorocyclopentene was treated with aluminum chloride, 1,2,3,3-tetrachlorotetrafluorocyclopentene, 3,3-difluorohexachlorocyclopentene, and octachlorocyclopentene were formed. Evidence for the assignment of structures to the chlorofluorocyclopentenes was based on spectral data and chemical reactions.

139 pages. $1.74. MicA 55-922

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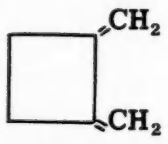
CYCLOBUTANE DERIVATIVES: (I) THE SYNTHESIS AND REACTIONS OF 1,2-DIMETHYLENECYCLOBUTANE. (II) AN INVESTIGATION OF METHODS FOR THE SYNTHESIS OF BENZOCYCLOBUTENE.

(Publication No. 11,382)

Carl H. Cunov, Ph.D.
Wayne University, 1951

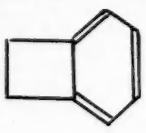
The synthesis of 1,2-dimethylenecyclobutane, structure (a), was undertaken because of the interest associated with its polymerization and Diels-Alder reaction products along with the fact that it has a unique structure in itself and might serve as a useful intermediate for the introduction of the cyclobutane nucleus into compounds having physiological activity. Polymers from 1,2-dimethylenecyclobutane facilitate

(a)



the completion of a study correlating the properties of polymers with the structure of the corresponding monomer. This type of study has appreciable military significance in the search for a rubber which maintains its strength and elasticity at low temperatures. An investigation of methods for the synthesis of benzocyclobutene, structure (b), is desirable since this compound and its derivatives would be of value in establishing the validity of the Mills-Nixon hypothesis

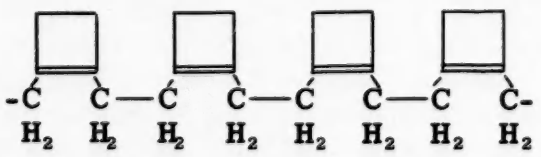
(b)



regarding the possible fixation of the double bonds in hydrindene derivatives. This in turn has an important bearing on the classical benzene structural problem.

The synthesis of 1,2-dimethylenecyclobutane from 1,2-cyclobutanedicarboxylic anhydride is outlined in Chart I. 1,2-Cyclobutanedicarboxylic anhydride was obtained by a series of reactions from adipic acid as shown in Chart II.

Polymerization of 1,2-dimethylenecyclobutane in the presence of benzoyl peroxide yields a rubbery, elastic solid which may well be the first synthetic all-cis polymer with rubber-like characteristics. A detailed determination of its structure, probably consisting largely of the units shown in (c), will be very difficult because of its insolubility in hot or cold benzene, toluene, xylene and chlorinated solvents. This

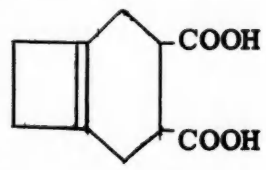


(c)

insolubility, possibly due to cross-linking, emphasizes the fact that such a polymer may prove to be very useful in practical applications. Polymers from a number of other similar cyclic conjugated dienes are crystalline and show no rubber-like characteristics whatsoever.

The Diels-Alder reaction of 1,2-dimethylenecyclobutane and maleic anhydride yields Δ 1,6-bicyclo-(4.2.0)octene-3,4-dicarboxylic acid, structure (d). An adduct is also formed with dibromomaleic anhydride. It is likely, therefore, that 1,2-dimethylenecyclobutane will also react with various other

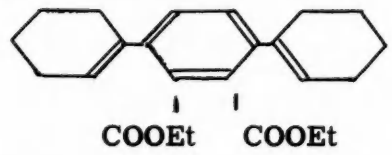
(d)



dienophiles to afford for the first time a general method for the synthesis of compounds containing fused four and six-membered rings.

Synthetic methods possibly leading to benzocyclobutene derivatives have been investigated. The Wurtz reaction of sodium and o-xylylene dibromide offers no hope in this regard. Used as a model compound prior to attempting a similar reaction with 1-ethynylcyclobutene, 1-ethynylcyclohexene dimerizes and then

(e)



reacts with diethyl acetylenedicarboxylate to form diethyl 3,6-di(1-cyclohexenyl) phthalate, structure (e). The Diels-Alder reactions of 1,2-dimethylenecyclobutane present the best possibility for a benzocyclobutene synthesis. 99 pages. $1.24. MicA 55-923

CONCENTRATION METHODS FOR MICROGRAM QUANTITIES OF RARE EARTHS IN THORIUM

(Publication No. 11,869)

Ferdinand Henry Firsching, Ph.D.
Syracuse University, 1955

The objective of this research was to develop possible ways to concentrate trace rare earth contaminations present in highly purified thorium. Such a study might lead to a new method for producing even purer thorium and/or facilitate estimation procedures for the trace rare earths present.

Two similar concentration methods for trace rare earths in thorium using ethylenediaminetetraacetic acid (EDTA) as the complexing agent have been developed. The stoichiometric behavior of EDTA with strongly complexed cations at low pH values, and the preferential dissociation of EDTA complexes with pH were utilized to hold a very large portion of thorium in solution as the Th-EDTA complex, while the uncomplexed trace rare earths and a very small portion of uncomplexed thorium are removed from solution.

Two different procedures, precipitation and ion exchange, for removing the uncomplexed ions from solution are presented. Precipitation concentrates

more than 98% of the microgram quantities of lanthanum with less than 1% of the original thorium taken; ion exchange concentrates more than 98% of the microgram quantities of lanthanum and yttrium with with about 4% of the original thorium taken.

A method has also been developed for eluting part of the thorium with most of the microgram rare earths retained on the ion exchange column.

In addition a modification of the Fritz-Ford method for the titration of thorium with EDTA is proposed which makes possible the estimation of thorium quantities in the 0.1 mg. range.

87 pages. $1.09. MicA 55-924

THE REACTION OF ACETYLENIC AND ALLENIC COMPOUNDS WITH COBALT CARBONYLS

(Publication No. 11,588)

Harold Greenfield, Ph.D.
University of Pittsburgh, 1955

This is a study of the reaction of alkynes and allenes with cobalt carbonyls at room temperature and atmospheric pressure, and of the reaction of alkynes with carbon monoxide and a cobalt carbonyl catalyst at elevated temperatures and pressures.

It has been found that an acetylenic compound can replace two carbonyl groups in dicobalt octacarbonyl to form a new type of organometallic compound which has been named an "acetylenic dicobalt hexacarbonyl." This reaction takes place smoothly and quantitatively at room temperature. The stoichiometry of the reaction and the elementary analyses and infrared spectra of the products have established that the alkyne, $RC{\equiv}CR'$, has replaced the two bridge carbonyl groups in dicobalt octacarbonyl, $Co_2(CO)_8$, and that the acetylenic dicobalt hexacarbonyl may be represented by the formula, $RC_2R'{\cdot}Co_2(CO)_6$. An attempt has been made to determine the structure of such acetylenic dicobalt hexacarbonyls. Two likely structures have been proposed. However, a choice between these structures cannot be made on the basis of the available data.

The chemical behavior of acetylenic dicobalt hexacarbonyls has been investigated in the presence of a variety of reagents, including oxidizing agents, reducing agents, acids, and basis. The thermal stability of these compounds has also been studied.

It has also been found that allenes react with dicobalt octacarbonyl at room temperature. The stoichiometry of the reaction and the nature of the products are different from that obtained from the reaction of alkynes with dicobalt octacarbonyl. The reaction with allenes results in the formation of an organometallic compound that appears to be capable of catalytically effecting the polymerization of allenes, but not of monoolefins.

An investigation has been made of the reaction of alkynes with carbon monoxide and hydrogen in the presence of a cobalt carbonyl catalyst at elevated temperatures and pressures (hydroformylation conditions). Depending upon the structure of the alkyne, either hydroformylated products or saturated hydrocarbons are obtained. The latter case is the first unequivocal example of the reduction of an acetylenic bond with synthesis gas (a mixture of carbon monoxide and hydrogen) in the presence of a cobalt catalyst.

It has been demonstrated that phenylacetylene reacts with carbon monoxide in the presence of a cobalt carbonyl catalyst at elevated temperatures and pressures. Several pure compounds have been obtained from the reaction products, and it has been shown that they are ketones containing definite stoichiometric ratios of phenylacetylene moieties to carbon monoxide moieties. This is the first example of the reaction of an alkyne with carbon monoxide in the presence of a cobalt catalyst and in the absence of more than traces of hydrogen and compounds containing an active hydrogen atom.

The reaction of acetylene with stoichiometric quantities of cobalt hydrocarbonyl at room temperature and atmospheric pressure results in the formation of propionaldehyde. This compound would also be a likely product from the reaction of acetylene under hydroformylation conditions, that is, with synthesis gas in the presence of a cobalt catalyst at elevated temperatures and pressures.

It has been found that the addition of an alkyne to reaction mixtures containing dicobalt octacarbonyl and nonacetylenic substrates inhibits subsequent reactions under hydroformylation conditions. The results of a study of this effect suggests that the inhibition is caused by the transformation of the dicobalt octacarbonyl catalyst into an acetylenic dicobalt hexacarbonyl.

A study of the effect of an acetylenic dicobalt hexacarbonyl on platinum-catalyzed hydrogenations suggests that these organometallic compounds may behave as selective poisons for the hydrogenation of alkynes to alkenes. 165 pages. $2.06. MicA 55-925

FREE RADICAL REARRANGEMENTS IN THE DECARBONYLATION OF ALDEHYDES

(Publication No. 11,458)

Marvin Joseph Hurwitz, Ph.D.
Columbia University, 1952

The extent of 1,2- carbon-to-carbon rearrangements occurring in free radical reactions in liquid or solution phase, of which only a few cases have been thus far reported, (1,2,3) has been studied here. To accomplish this research, a series of highly substituted propionaldehydes were synthesized, differing in the nature and position of the substituents. Four of these aldehydes were decarbonylated using di-t-butyl peroxide as catalyst, (2) thus generating alkyl free radicals having different electronic and steric driving force for rearrangement of a beta substituent to the alpha carbon.

The aldehydes employed were synthesized by an

extension of the method of Nesmeyanov. (4) Three enol acetates of aldehydes, namely, vinyl acetate, n-propenyl acetate, and n-butenyl acetate, (the latter two prepared by the treatment of propionaldehyde and butyraldehyde, respectively, with acetic anhydride), were treated with aqueous mercuric acetate and then with potassium chloride to give the α-chloromercuri-acetaldehyde, -propionaldehyde and -butyraldehyde. These were each coupled with triphenylmethyl chloride to yield respectively, β,β,β-triphenylpropion-aldehyde, β,β,β-triphenyl-α-methylpropionaldehyde, and β,β,β-triphenyl-α-ethylpropionaldehyde. Chloro-mercuriacetaldehyde was also successfully coupled with p-methoxybenzhydryl chloride and α,α-diphenyl-ethylchloride to yield, respectively, β-p-anisyl-β-phenylpropionaldehyde and β,β-diphenylbutyraldehyde. Chloromercuriacetaldehyde was found to couple with benzhydryl chloride only in the presence of stannic chloride catalyst to yield the β,β-diphenylpropion-aldehyde.

Four of the above prepared aldehydes were subjected to peroxide-catalyzed decarbonylation. Decarbonylation of β,β,β-triphenylpropionaldehyde gave only the rearranged saturated hydrocarbon, 1,1,2-triphenylethane and recovered aldehyde. From the decarbonylation of β,β,β-triphenyl-α-methylpropion-aldehyde two hydrocarbons, 1,1,2-triphenylpropane and 1,1,2-triphenylpropene were obtained in approximately equal amounts. (Both have skeletons formed by rearrangement with migration of phenyl and are presumably disproportionation products.) β-p-Anisyl-β-phenylpropionaldehyde gave at least 85% of 1-p-anisyl-1-phenylethane (carbon skeleton unrearranged). β,β-Diphenylbutyraldehyde gave only 2,3-dimethyl-1,2,3,4-tetraphenylbutane (the dimer of the radical arising from migration of phenyl). The products were all identified by mixed melting points and comparison of the infrared spectra with authentic samples. In no case was the total starting material which was accounted for less than 75%.

It is seen that the driving force obtained by the transformation of a primary to the more stable tertiary benzhydryl radical and even to tertiary benzyl radical as well as of a secondary to a tertiary benzhydryl is sufficient for complete migration of phenyl, but not of methyl. Primary to secondary benzyl was insufficient driving force for more than 15% migration of phenyl; in this case the competing reaction may have been migration of hydrogen where the driving force was primary to tertiary benzhydryl.

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93 pages. $1.16. MicA 55-926

THIOLACRYLIC ESTERS: THEIR PREPARATION, POLYMERIZATION AND COPOLYMERIZATION WITH VINYL MONOMERS AND 1,3-BUTADIENE

(Publication No. 11,512)

S. Lawrence Jacobs, Ph.D.
University of Illinois, 1955

INTRODUCTION

Thiolacrylic esters are new compounds that have never before been polymerized. The present investigation has been undertaken to study their polymerization and to determine what effect the sulfur atom will have on the polymerization of the esters and what characteristics it will confer upon their polymers as compared with those of the oxygen analogs. The polymers and copolymers of acrylates are well-known and have recently been reviewed. (1)

DISCUSSION

A series of seven alkyl thiolacrylic esters has been prepared by way of the corresponding α,β-dibromothiolpropionates. Their physical properties have been enumerated and their infrared spectra obtained. The observation that conjugated carbonyl absorption in the infrared was shifted further from that for unconjugated esters than was the corresponding band for the acrylates was compatable with the observations on the relative polymerization reactivities of the sulfur- and oxygen-analogs. Heretofore, thiolacrylates have received only brief mention in the literature. (2)

A comparison was made of the activity of the thiolacrylates in polymerization reactions with that of the acrylates. It was found that the thiolacrylic esters were generally more reactive. The reactivity ratios for the copolymerization of butadiene (M_1) with methyl thiolacrylate (M_2) were determined and found to be $r_1 = 0.35 \pm 0.01$ and $r_2 = 0.20 \pm 0.05$. These were compared with the corresponding values for the copolymerization of butadiene with methyl acrylate. The lesser tendency of the sulfur to contribute electrons in a resonating system was postulated to be the cause of a greater copolymerization tendency of the thiolacrylates with butadiene as compared to that of the acrylates with butadiene.

The copolymerization of these compounds with acrylonitrile, styrene, trichloroethylene, i-butyl vinyl ether, maleic anhydride, methyl acrylate, vinyl acetate, allyl acetate, 2-vinylpyridine and 1,3-butadiene has been investigated. Particular interest in synthetic rubber chemistry placed emphasis on the copolymerization of the thiolacrylates with butadiene in order to determine what effect the sulfur-containing ester would have upon the elastomeric product. It was hoped that a low-hysteresis rubber would be produced due to fewer possibilities for chain interaction by hydrogen-bonding. At this writing, however, physical evaluation data are not yet available.

In general, it was discovered that the polymers and copolymers of the thiolacrylic esters have higher softening points and are considerably tougher than the

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corresponding acrylate-containing polymers. Except for the high cost of the mercaptans, there is little doubt that thiolacrylic esters could substitute for or replace acrylates in many polymeric materials.

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75 pages. $1.00. MicA 55-927

A STUDY OF THE REACTION OF TETRAALKYLMETHYLENEDIAMINES WITH ACTIVE HYDROGEN COMPOUNDS

(Publication No. 11,474)

Roger Alvin Johnson, Ph.D.
The University of Florida, 1955

Four new Mannich bases have been prepared. They were formed by reacting tetraethylmethylenediamine with the active hydrogen compound 2-nitropropane, p-nitrophenylacetonitrile, 2,4-dinitroethylbenzene, and ethyl nitroacetate. Analyses were obtained for all four Mannich bases.

By the use of carbon-14, it was possible to demonstrate that when tetraethylmethylenediamine was reacted with 2-methyl-2-nitro-1-propanol, it was the latter which broke down into 2-nitropropane and formaldehyde. It was found that when tetraethylmethylenediamine-methyleneyl-C^{14} was reacted with 2-methyl-2-nitro-1-propanol, the majority of the radioactivity was found in the Mannich base, 1-diethylamino-2-methyl-2-nitropropane. But, when 2-methyl-2-nitro-1-propanol-1-C^{14} was reacted with tetraethylmethylenediamine, only a small fraction of the radioactivity was found in the Mannich base.

A study of the reaction between tetraethylmethylenediamine and 2-nitropropane was made in the presence of varying amounts of hydrogen chloride. Aqueous and alcoholic systems were used. It was found that the yield of 1-diethylamino-2-methyl-2-nitropropane decreased with increasing hydrogen ion concentration. The decrease was noted to a lesser extent in the alcholic system.

A mechanism has been proposed for the reaction between active hydrogen compounds and tetraalkylmethylenediamines. If the formation of the tetraethylmethylenediamine is postulated as the first step in the Mannich reaction, then the mechanism developed here would be that of the Mannich reaction.

79 pages. $1.00. MicA 55-928

ANALYTICAL APPLICATIONS OF ORGANIC FLUORINE COMPOUNDS

(Publication No. 11,635)

Frederick William Kingdon, Ph.D.
Purdue University, 1955

Major Professor: M. G. Mellon

Several fluorine-containing 1,3-diones were tested for potential use as reagents in the absorptimetric determination of metal ions. Colored systems were observed with a number of metal ions, especially of the first transition series of elements. No unusual effects were noted, and in no case was the color of the system deep enough to show the reagent as more sensitive than some other method. These 1,3-diones could be used for the absorptimetric determination of some metals in limited concentration range.

Details of a method for determining Fe(III) by means of 4,4,4-trifluoro-1-(2-thenyl)-1,3-butanedione commonly referred to as thenoyl-trifluoroacetone, or TTA) were worked out. A suitable solvent system, the effect of hydrogen ion concentration, and the degrees of interference of numerous other ions in this method were found.

Routine tests for acetone were applied to some halogenated acetones, including 1,1,1,-trifluoroacetone. The ultraviolet spectrum of the 2,4-dinitrophenylhydrazone of an acetone proved to be a successful analytical property. Bromo-, chloro-, and 1,1,1-trifluoroacetone can be determined in one-tenth milligram quantity by a method adapted from the standard Greenberg and Lester procedure.

120 pages. $1.50. MicA 55-929

SOME ASPECTS OF THE ELECTRICAL EFFECTS OF THE SULFONE GROUP

(Publication No. 11,637)

Robert Herman Knospe, Ph.D.
Purdue University, 1955

Major Professor: Dr. William E. Truce

I. The Preparation of β-Keto Sulfones by the Claisen Condensation

A convenient method of synthesis for several β-keto sulfones was desired in connection with an investigation of the acidity of these compounds. The Claisen condensation has been extended to include both inter- and intramolecular condensations of esters with active methylene compounds in which one sulfone group is the only activating species.

Ethyl β-methylsulfonylpropionate, prepared by oxidation and esterification of β-methylmercaptopropionic acid, on treatment with sodium ethoxide gave an elimination reaction instead of cyclization. Ethyl methylsulfonylpivalate, prepared by treating sodium chloropivalate with sodium methylmercaptide

followed by oxidation and esterification of the resulting sulfide acid, gave, however, 4,4-dimethyltetrahydrothiophene-3-one-1-dioxide. 4,4-Dimethyltetrahydrothiophene-3-one on oxidation with hydrogen peroxide gave bis(2-carboxy-2-methylpropyl) disulfide instead of the desired keto sulfone. Treating sodium chloropivalate with sodium thiosulfate followed by the action of iodine on the resulting Bunte salt, gave the same disulfide. Ethyl γ-methylsulfonylbutyrate, prepared by esterification and oxidation of the sulfide acid, gave tetrahydrothiapyran-3-one-1-dioxide. Ethyl δ-Methylsulfonylvalerate was prepared by treating δ-chloro valeronitrile with sodium methylmercaptide in base, followed by esterification and oxidation of the resulting sulfide acid. This sulfane ester gave 2-methylsulfonylcyclopentanone on treating with sodium ethoxide. Similarly ethyl ϵ-methylsulfonylcaproate, prepared by treating ethyl ϵ-bromocaproate with sodium methylmercaptide, followed by oxidation of the resulting sulfide ester, gave 2-methylsulfonylcyclohexanone. Ethyl benzoate has been condensed with both methyl phenyl sulfone and dimethyl sulfone to give ω-phenylsulfonylacetophenone and ω-methylsulfonylacetophenone respectively.

II. The Acidity of β-Keto Sulfones

Even though it is well known that β-keto sulfones exhibit acidity to a certain degree, no quantitative studies have been reported. The following apparent dissociation constants (measured in 50% ethanol by potentiometric titration) were obtained for a series of acyclic β-keto sulfones: methylsulfonylacetone, pK = 10.48 $\mp$ 0.01; phenylsulfonylacetone, pK = 10.09 $\pm$ 0.02; ω-methylsulfonylacetophenone, pK = 10.01 $\pm$ 0.02; ω-phenylsulfonylacetophenone, pK = 9.83 $\pm$ 0.02. The trend observed seems to be a consequence of the relative differences between the inductive effect of the methyl versus the phenyl group.

The following dissociation constants (measured in water) were found for two cyclic β-keto sulfones: Methylsulfonylacetone (included for comparison), pK = 9.90 $\pm$ 0.01; tetrahydrothiapyran-3-one-1-dioxide, pK = 9.00 $\pm$ 0.02; 4,4-dimethyltetrahydrothiophene-3-one-1-dioxide, pK = 5.83 $\pm$ 0.01. This series is in contrast to that of the analogous β-diketones: acetylacetone, (1) pK = 8.94; 1,3-cyclohexanedione, (1) pK = 5.26; 4,4-dimethyl-1,3-cyclopentanedione, (2) pK = 4.2. An explanation is offered for the difference observed on incorporating the β-diketone linkage versus the β-keto sulfone linkage into a six-membered ring.

III. The Relationship Between Conjugation and Bond Conformation in Alkyl Aryl Sulfones

In contrast to most other groups capable of conjugation, no report on the inhibition of resonance of the sulfone group has appeared. Several authors (3,4) have previously concluded that a planar configuration of the sulfone group is not a condition for its resonance.

An attempt was made to show that the conjugation of the tetrahedral sulfone group with an aromatic nucleus depends on its rotational conformation about the $C_{aromatic}$-S bond, by means of ultraviolet absorption spectra. Two conformations were studied: one in which the oxygen-oxygen axis of the sulfone group is perpendicular to the pi orbitals of the adjacent aromatic nucleus (conformation A); the other in which a parallel arrangement is present (conformation B). t-Butyl mesityl sulfone appeared to be representative of conformation A. By similarities in the primary band shifts in a series of t-butyl- and methyl aryl sulfones it was concluded that inhibition of resonance is not operative in conformation A. 2,3-Dihydrothianaphthene-1-dioxide appeared to be representative of conformation B. A comparison of its spectrum with that of methyl p-tolyl sulfone indicated displacement of the primary band maximum of the former compound to lower intensities and shorter wave lengths as compared to the latter. This may be interpreted as evidence for the steric inhibition of resonance in conformation B. Supporting evidence is furnished by the observation of a gradual shift of the bands to longer wavelengths as the size of the hetero ring is increased to six- and seven-members. It also appears that one methyl group in the ortho position of methyl phenyl sulfone constrains the molecule to conformation B. Thus the primary band maximum of methyl o-tolyl sulfone is shifted to lower wavelengths and intensities as compared to the para isomer.

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160 pages. $2.00. MicA 55-930

THE PREPARATION OF CERTAIN COMPOUNDS CONTAINING THE PERFLUOROVINYL GROUP

(Publication No. 11,476)

Marvin Russell Lilyquist, Ph.D.
The University of Florida, 1955

In the course of this research a study has been made of the reaction of 1,2-dibromo-2-chloro- and 1,2-dichloro-2-iodo-1,1,2-trifluoroethane with various fluoroethylenes and fluoropropylenes. The iodine compound gives excellent yields of addition products even with olefins which fail to react with the dibromide. The high yields of adducts from these perhaloethanes and the ease with which the addition compounds can be dehydrohalogenated and dehalogenated affords a good synthetic method for the preparation of various fluoroölefins and fluorobutadienes which contain the perfluorovinyl group. In this manner twelve new addition products have been prepared which were converted into nine new fluoroölefins and six new fluorobutadienes.

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In addition a convenient laboratory synthesis of 2-fluorobutadiene-1, 3 from butene-2 has been described. This method uses commercially available materials and can be carried out with laboratory apparatus, thereby avoiding the use of special equipment and handling of the highly explosive material required in the catalytic addition of anhydrous hydrogen fluoride to vinyl acetylene.

A study of the infrared absorption spectra of fluorine-containing olefins and dienes has been made and a pronounced shifting of the carbon-carbon double bond stretching vibration in the direction of shorter wavelengths was observed. Absorption frequencies for the carbon-carbon double bond stretch have been assigned for the groups, CHR=CR-, where R represents a hydrogen atom, a methyl group, or a trifluoromethyl group, CHF=CH-, CF_2=CH- and CF_2 =CF-.

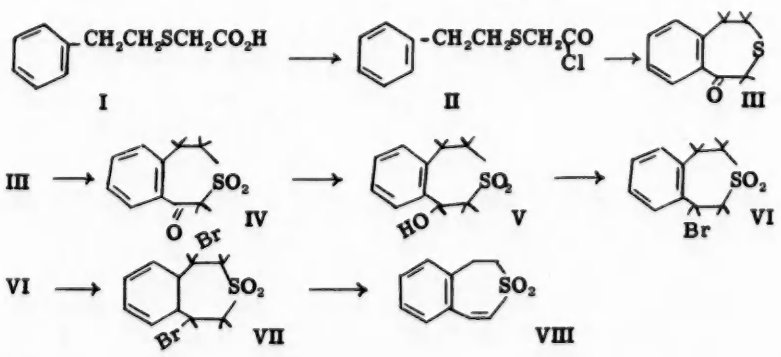
83 pages. $1.04. MicA 55-931

THE PREPARATION AND PROPERTIES OF 3-BENZOTHIEPIN-3-DIOXIDE

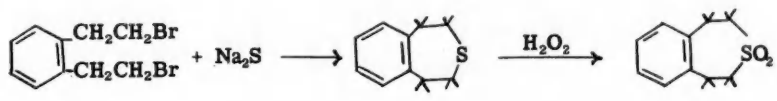
(Publication No. 11,638)

Frederick Jackson Lotspeich, Ph.D.
Purdue University, 1955
Major Professor: William E. Truce

This investigation was concerned with the preparation and properties of 3-benzothiepin-3-dioxide, the sulfone analog of benzotropone. The highly unsaturated and completely conjugated character of the seven-membered ring of 3-benzothiepin-3-dioxide makes it a potential aromatic system, since the sulfone group like the carbonyl group is capable of conjugation by electron attraction. Initial attempts to prepare 3-benzothiepin-3-dioxide by condensing bis(carbethoxymethyl) sulfide and bis(carbethoxymethyl) sulfone with o-phthalaldehyde in the presence of sodium hydroxide, diethylamine and sodium ethoxide were unsuccessful. Likewise, unsuccessful attempts were made to prepare 3-benzothiepin-3-dioxide or its derivatives by condensing (1) o-phthalaldehyde with bis(carbethoxymethyl) sulfide followed by oxidation and decarboxylation, or (2) o-phthalaldehyde and diethyl phthalate with dibenzyl sulfone, diphenacyl sulfone and dimethyl sulfone. Furthermore, 3-benzothiepin could not be prepared by treating the sodium salt of o-bis(carboxymethyl)benzene with phosphorus pentasulfide. The synthesis of 3-benzothiepin-3-dioxide was finally achieved by the following series of reactions:



The structure of 3-benzothiepin-3-dioxide was established by reducing it to 1,2,4,5-tetrahydro-3-benzothiepin-3-dioxide and comparing it with a sample of 1,2,4,5-tetrahydro-3-benzothiepin-3-dioxide in the following manner:



3-Benzothiepin-3-dioxide was also converted into naphthalene by pyrolysis.

3-Benzothiepin-3-dioxide decolorized a solution of bromine in chloroform and potassium permanganate in acetone. It was readily reduced to VIII and appeared to be nitrated in the benzene nucleus when treated with fuming nitric acid. Furthermore, selenium dioxide, which has been used to dehydrogenate certain compounds to resonance stabilized systems, failed to convert 1,2-dihydro-3-benzothiepin-3-dioxide to 3-benzothiepin-3-dioxide. Thus, it appears that the seven-membered ring of 3-benzothiepin-3-dioxide is non-aromatic.

145 pages. $1.81. MicA 55-932

A STUDY OF THE REACTIONS OF CERTAIN HALOGENATED ACIDS AND ESTERS WITH ORGANOLITHIUM COMPOUNDS

(Publication No. 11,597)

Thomas F. McGrath, Ph.D.
University of Pittsburgh, 1955

The synthesis of ketones and carbinols of the structures $RCOC_nF_{2n+1}$ and $R_2C(OH)C_nF_{2n+1}$, where n is 1, 2, or 3 and R is the phenyl or 2-picolyl radical, has been accomplished by the interaction of the methyl esters of trifluoroacetic acid, perfluoropropionic acid and perfluoro-n-butyric acid with phenyl- or 2-picolyllithium.

The diphenylperfluoroalkylcarbinols were obtained in yields of over 80 per cent by adding one equivalent of each of the esters to two of phenyllithium in refluxing ether. The perfluoroalkyl phenyl and 2-picolyl ketones were prepared by adding one equivalent of the appropriate organolithium compound to one of the appropriate ester at 25°C. Although the reactions of 2-picolyllithium with the fluorinated esters gave the corresponding ketones in yields of over 80 per cent, the reactions of phenyllithium with these esters gave mixtures of the corresponding phenyl perfluoroalkyl ketones and diphenylperfluoroalkylcarbinols.

The phenyl perfluoroalkyl ketones have also been synthesized from the interaction of fluorinated acids with phenyllithium. Thus, the addition of one equivalent of each of the fluorinated acids to two phenyllithium at -65°C. gave a mixture of the corresponding phenyl perfluoroalkyl ketone and benzoic acid.

When one equivalent of trifluoroacetic acid was added to from two to seven equivalents of phenyllithium

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in refluxing ether, none of the desired trifluoroacetophenone was formed. Instead, the following abnormal products were produced: benzoic acid, benzophenone, triphenylmethane, and tetraphenylethylene. These products arise from the cleavage of the initially formed lithium trifluoroacetate to carbon dioxide and fluoroform. That carbon dioxide will react with phenyllithium to give a mixture of benzoic acid and benzophenone is reported in the literature. In the present study it has been found that the reaction of fluoroform with phenyllithium gives a mixture of triphenylmethane and tetraphenylethylene.

In connection with the work on fluoroform, it was of interest to study the reactions of the other haloforms with phenyllithium. Using chloroform, both triphenylmethane and tetraphenylethylene were also obtained. However, in the bromoform reaction, a mixture of bromobenzene and trans-stilbene was produced while iodobenzene and sym-tetraphenylethane were isolated in the iodoform reaction. It is suggested that the phenyllithium first reacts with each of the haloforms to give the corresponding benzal halide. Then, the benzal fluoride and chloride react with more phenyllithium by an acid-base reaction while the bromide and iodide react by a transmetalation process.

The reaction of perfluoropropionic acid and phenyllithium in refluxing ether was also abnormal. None of the desired phenyl perfluoroethyl ketone was obtained. Instead, a mixture of benzophenone, sym-diphenyldifluoroethylene and triphenylfluoroethylene was isolated. The course of this reaction has been shown to involve the formation of lithium perfluoropropionate which is cleaved to give carbon dioxide, tetrafluoroethylene, and lithium fluoride. The carbon dioxide then reacts with some of the phenyllithium to give benzophenone. That the sym-diphenyldifluoroethylene and triphenylfluoroethylene arise from the reaction of tetrafluoroethylene and phenyllithium was shown by bubbling tetrafluoroethylene, produced by the pyrolysis of sodium perfluoropropionate, through an ethereal solution of phenyllithium and obtaining these olefins. From a comparable reaction between phenyllithium and perfluoro-n-butyric acid only a red crystalline solid, m.p. 150.8-151.5°, of unknown structure was isolated.

The reactions of the three chlorinated acetic acids with phenyllithium in refluxing ether were also studied. Trichloroacetic acid gave the same abnormal products as were observed in the trifluoroacetic acid-phenyllithium reaction; dichloroacetic acid gave only intractable tars from which it was impossible to isolate any pure products; and monochloroacetic acid gave a mixture of benzophenone and triphenylmethane (abnormal products) and unsym-diphenylethylene glycol (normal product).

133 pages. $1.66. Mic 55-90

PYRAZINE ANALOGS OF THE PURINES

(Publication No. 11,425)

Frank L. Muehlmann, Ph.D.
University of Pennsylvania, 1955

Supervisor: Allan R. Day

The purpose of the work presented in this thesis was to prepare pyrazine analogs of purines with the hope that they might find use as metabolic antagonists of pyrimidines or purines and thus retard or arrest cell growth.

The ultimate intermediate in the reaction scheme for the preparation of imidazo [b] pyrazines was 2,3-diaminopyrazine. Aminomalonamide and glyoxal sodium bisulfite reacted to form 2-hydroxy-3-carboxamidopyrazine. This compound, when subjected to the Hofmann reaction, yielded 2-hydroxy-3-aminopyrazine. Upon reacting this with phosphorous oxychloride, the 2-chloro-3-aminopyrazine was formed. When 2-chloro-3-aminopyrazine was heated at 135° in an autoclave with concentrated ammonium hydroxide and a trace of copper, 2,3-diaminopyrazine resulted.

2,3-Diaminopyrazine was treated with ethyl orthoformate to yield imidazopyrazine. When 2,3-diaminopyrazine reacted with acetic anhydride, 2-methylimidazopyrazine resulted. On reacting 2,3-diaminopyrazine with urea, 2-hydroxyimidazopyrazine was formed. Glycollic acid reacted with 2,3-diaminopyrazine to form 2-hydroxymethylimidazopyrazine. These are all new compounds.

A few additional new compounds were made which are related to the intermediates mentioned earlier. These included 2-hydroxy-3-carboxamido-6-methylpyrazine, made from aminomalonamide and methylglyoxal sodium bisulfite, and 2-hydroxy-3-amino-6-methylpyrazine obtained from the aforementioned carboxamido compound by the Hofmann reaction. In addition, 2,5(6)-dihydroxy-3-carboxamido-5(6)-methylpyrazine was obtained from aminomalonamide and ethyl pyruvate. The treatment of this carboxamido compound by the Hofmann reaction failed to yield the amino compound.

All the steps leading to the 2,3-diaminopyrazine appear in the literature. The first step, the condensation of glyoxal and aminomalonamide, however, did not give the yields claimed in the literature. Not until glyoxal sodium bisulfite and heat were used were good yields obtained. The next step, the Hofmann reaction, usually gave good yields. The following step, the conversion of the 2-hydroxy-3-aminopyrazine to the 2-chloropyrazine using phosphorous oxychloride, however, resulted in a complete failure to obtain the yields claimed by the literature. This was overcome, finally, by the formation of additional hydrogen chloride in the reaction mixture by adding small quantities of water to the closed system.

The reaction product obtained from methylglyoxal sodium bisulfite and aminomalonamide was not the same as that obtained by the reaction between methylglyoxal and aminomalonamide. In the latter case, 2-hydroxy-3-carboxamido-5-methylpyrazine was

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obtained. We, however, using methylglyoxal sodium bisulfite obtained 2-hydroxy-3-carboxamido-6-methylpyrazine.

The attempted conversion of 2-hydroxy-3-amino-6-methylpyrazine to the corresponding 2-chloro compound was unsuccessful.

The conversion of the 2-chloro-3-aminopyrazine to the 2,3-diaminopyrazine was accomplished with little difficulty and the yields in the literature were duplicated.

The formation of the imidazopyrazines was also accomplished with little difficulty. Good yields were obtained along with excellent analyses for the expected products.

These compounds are potential metabolic antagonists and were made with the hope that they might prove useful in the treatment of cancer. The tests for their activity has not been completed.

35 pages. $1.00. MicA 55-933

POLYMERIZATION STUDIES OF UNSATURATED DERIVATIVES OF BETA-NITROSTYRENE

(Publication No. 11,479)

James Lewis Nash, Jr., Ph.D.
The University of Florida, 1953

Seven aldehydes and nine β-nitrostyrenes not reported previously in the literature were prepared for polymerization studies. Physical constants were determined and analyses made for each new compound.

Only β-nitrostyrenes which were ortho substituted with regards to the 2-nitrovinyl group failed to produce insoluble polymers when subjected to polymerization with sodium methoxide. Aldehydes containing the vinyloxy group polymerized, whereas the β-nitrostyrenes containing the same group were recovered as the monomer when treated with the catalyst, $BF_3 \cdot (C_2H_5)O$. Infrared evidence pointed to an inhibition or prevention of the electron shift in the vinyloxy group which was necessary to permit polymerization.

The aldehydes and β-nitrostyrenes were polymerized singly, and copolymerized individually, with maleic anhydride using benzoyl peroxide as the catalyst. The aldehyde in all cases showed a greater tendency to polymerize than did its analogous β-nitrostyrene derivative.

The two-stage polymerizations which were proposed originally, were not practical because of the lack of solubility of the polymers obtained with sodium methoxide, the lack of reactivity of the vinyloxy group in the β-nitrostyrenes toward BF_3 and the slight tendency of the β-nitrostyrenes to polymerize with benzoyl peroxide. 90 pages. $1.13. MicA 55-934

A STUDY OF SOME AZO NITRILES

(Publication No. 7697)

Arthur Nersasian, Ph.D.
University of Michigan, 1954

The purpose of this investigation was to determine the effect of electron-attracting and -releasing groups on the rates of decomposition of azo compounds of the type $RR'C(CN)N = N(CN)CR'R$, where R is phenyl or substituted phenyl and R' is alkyl or aryl. Experimental evidence indicated, however, that most of the azo compounds that were prepared contain one chlorine atom in place of one cyano group in the above formula. The energies of activation for the decomposition of these latter compounds and the effects of solvent on their rates of decomposition were determined.

Acetophenone and substituted acetophenone azines were allowed to react with hydrogen cyanide. Most of the azines investigated added one mole of hydrogen cyanide to form the corresponding cyano hydrazones. From the work of others, it was expected that two moles of hydrogen cyanide would add to form hydrazo dinitriles. These latter compounds were obtained, however, in only a few cases. Infrared spectra have been determined for most of the above nitriles.

Cyano hydrazones derived from acetophenone and p-methyl-, p-bromo-, p-chloro-, and 3,4-dichloro-substituted acetophenone azines were oxidized with chlorine in hydrochloric acid. The azo compounds obtained are believed to have the structure of the azo chloronitriles mentioned above. Decomposition rates for these compounds were determined in acetone at 12^0 and were found to follow first order kinetics. The presence either of electron-releasing groups, for example methyl, or electron-attracting groups, for example halogens, resulted in an increase of the rate of decomposition over the unsubstituted parent compound. From rate measurements at 0^0 and 12^0, energies of activation of the order of 22 kcal./mole were calculated for the decomposition of the azo compounds derived from acetophenone and p-methylacetophenone azines. The decomposition of the former compound was measured in various solvents at 12^0 and its rate was found to be independent of solvent medium. The products from the decomposition of the acetophenone derivative were isolated and included sym.-diphenyldimethylsuccinonitrile and 2,3-diphenyl-2-cyano-3-chlorobutane, which indicated the formation of free radicals during the decomposition.

Attempts were also made to prepare azo dinitriles in which R is the heterocyclic group thienyl, pyrryl, or furyl. However, azines containing heterocyclic groups in which the C=N function of the azine is in a position beta,gamma to the hetero atom S, O, or N would not add hydrogen cyanide under the reaction conditions used. It is believed that this non-reactivity is due to conjugation of the hetero atom with the unsaturated C=N group.

The following conclusions are drawn: 1) Electron-attracting and -releasing groups do not affect the rates of decomposition of the azo compounds studied in this investigation as would be expected from

Hammett's sigma-rho relationships. 2) The rates of decomposition follow first order kinetics and are unaffected by solvent medium. 3) The decomposition proceeds presumably via a free radical mechanism.

126 pages. $1.58. MicA 55-935

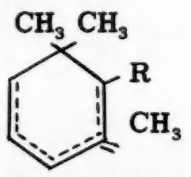
THE STRUCTURES AND MECHANISM OF FORMATION OF THE CYCLOGERANIOLENES

(Publication No. 11,428)

George Carroll Oppenlander, Ph.D.
University of Pennsylvania, 1955

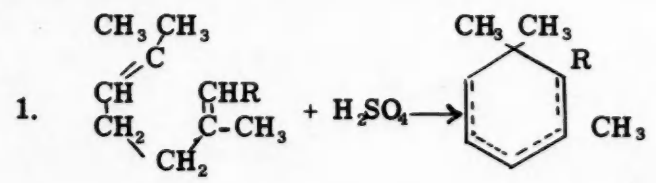
Supervisor: Allan R. Day

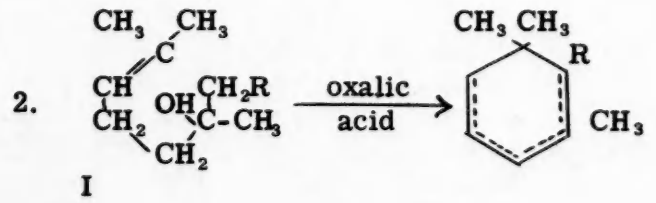
The cyclogeraniolenes are cyclic monoolefinic terpenes and may be represented by the following generalized formula:



R represents either H, as in the parent compound, cyclogeraniolene, or alkyl, in which case it is named by prefixing cyclogeraniolene with the name of the alkyl group. The cyclogeraniolenes have been considered mixtures of double bond isomers. The double bond in each isomer is located by prefixing the name with the Greek letter denoted in the above formula.

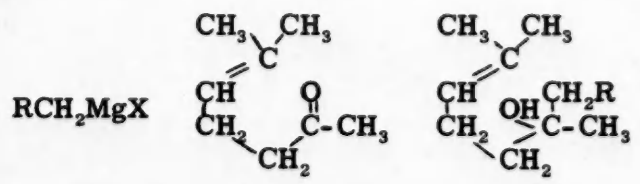
The cyclogeraniolenes are prepared by two general methods:





I

The second method is more general, since the alcohol (I) is readily prepared by the action of the appropriate Grignard reagent (II) upon methylheptenone (III).



II III I

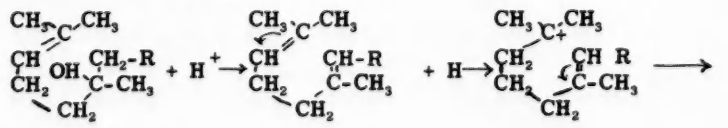
The first has been restricted to the two cases, cyclogeraniolene (R=H) and methylcyclogeraniolene ($R=CH_3$).

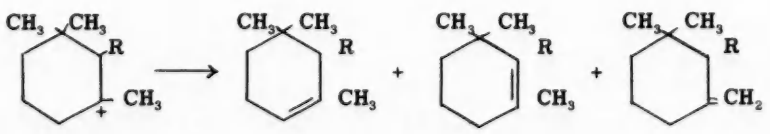
There is considerable conflict in the literature as to the composition of each member of the series with regard to which of the double bond isomers predominate. Of the more recent investigators, Escourrou concluded that all members of the series prepared by the second method consist almost entirely of the γ-isomers, since their ozonolyses yielded large quantities of formaldehyde. Dupont, on the basis of both chemical evidence and an interpretation of the Raman spectrum of methylcyclogeraniolene prepared by the secon method, assigned to it the following composition: 50% ϵ-isomer, 20% γ-isomer, and 30% α-isomer.

In this study, an intensive investigation was made into the structures of the cyclogeraniolenes in general and methylcyclogeraniolene in particular. The information gained here from the ozonolysis and subsequent identification of the cleavage products of methylcyclogeraniolene (method 2) together with an analysis of its infra red spectrum has led to the following structure assignment: β-isomer $\sim$ 72%, α-isomer $\sim$ 35%, γ-isomer $\sim$ 5%. No definite evidence is given for either the δ - or ϵ-isomers. Methylcyclogeraniolene (method 1) is similar in composition to that prepared by the second method except that it contains a slightly larger amount of the γ-isomer together with 15% unreacted starting material. When metaphosphoric acid was substituted for oxalic acid in the second method, the product was mostly diolefin (64%). The γ- and α-isomers make up the large part of the cyclic olefin content.

The infra red spectra of the parent compound, the ethyl, dimethyl, and n-propyl derivatives as prepared by the second method indicate the following: The γ-isomer in each case is present to the extent of only a few percent. The order of isomer content of the ethyl and propyl derivatives is $\beta > \alpha > \gamma$. Dimethylcyclogeraniolene, which has no β-isomer, consists of approximately 50% α-isomer together with what appears to be another cyclic olefin with a carbon skeleton different from that assigned to the cyclogeraniolenes. Cyclogeraniolene contains its isomers in the order $\alpha > \beta > \gamma$. As in the case of methylcyclogeraniolene, no definite evidence is given for the ϵ- or δ -isomers.

The following mechanism is suggested for cyclogeraniolene formation:





IV

123 pages. $1.54. MicA 55-936

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A STUDY OF POLYSULPHIDE LINKAGE IN ORGANIC MOLECULES

(Publication No. 10,989)

Jethalal Dahyalal Parikh, Ph.D.
Princeton University, 1949

Unlike many ether groups of organic compounds, study of organic polysulphides has been marked by investigations from physical as well as chemical stand-points. As a result of the work done so far, certain broad understandings of polysulphides have been reached which of late have thrown some light on their constitutions and properties though definite conclusions are still to be arrived at.

The purpose of the present investigations was to make a chemical study of polysulphide linkage in a variety of organic compounds, aliphatic as well as aromatic, the latter including an outstanding representative (the so-called sulphur-Black T) of the class of Sulphur Dyes which bear polysulphide bends on their molecules. The second chapter describes the preparations and chemical behaviour of six polysulphides, four of which are tetrasulphides and two trisulphides. One of the tetrasulphides prepared, Bis[4,6,6 - trimethyl -2- thiazinyl] tetrasulphide, can be regarded as a synthetic sulphur dye, in as much as it dissolves in cold Na_2S solution and is constituted of substituted thiazine nucleii joined by a tetrasulphide bridge. Also, unlike the classical sulphur dyes, it is crystalline and melts at 82-83°C (corr.).

The tetrasulphides are prepared by treating the sodium derivative of the mercaptan concerned with freshly distilled sulphur monochloride (S_2Cl_2), using a little above two mols of the mercaptide per one mol. of S_2Cl_2. The trisulphides were secured from the respective tetrasulphides by making use of the tendency of the latter to loose sulphur and thereby get converted to trisulphides.

It is known that when a polysulphide is subjected to a reductive treatment it looses a part of its total sulphur content in the form of N_2S. Quantitative estimations have been made of N_2S evolved when these polysulphides are reduced by Zn and acetic acid. The H_2S evolved was determined volumetrically by absorbing it in cadmium acetate solution, dissolving the precipitated CdS in concentrated HCl and a measured excess of standard I_2 solution, and titrating the excess I_2 with standardised $Na_2S_2O_3$ solution. The results obtained conclusively prove that sulphur atoms of the polysulphide chain which are directly attached to carbons are unattacked, but that the sulphur atoms of the chain other than these attached directly to a carbon are removed.

Further, a systematic study is made of the solubility properties of di- and poly- sulphides with a view to clarify the none-too-clear aspect of the characteristics of sulphur dye-molecules which render them soluble in aqueous Na_2S solution. All the four classes of compounds, di- and poly- sulphides with and without thiazine nucleii, have been tested for solubility in Na_2S solution. A very interesting fact which emerged from this survey is that the solubility of di- and poly- sulphides in aqueous Na_2S solution is in some way connected with the presence of thiazine nucleii and that the presence of di- and poly- sulphide linkages is not enough to render the molecule soluble in that solvent and to so impart it the characteristics of sulphur dyes.

The third chapter deals with a study of sulphur chains in Sulphur-Black T molecule whose complete structure is still a riddle in dye chemistry. The results obtained show that the amount of total labile sulphur (15.36% found) as removed by reduction with Zn and acetic acid and by air-oxidation under heat of a part of it is close to one half of the total sulphur content (31.29% Found) of the dye. Further, it is also found that removal of one sulphur atom by air-oxidation to H_2SO_4 is a necessary step for the complete removal of labile sulphurs by acidic reduction to H_2S.

In the fourth chapter are recorded some experiments on sulphur dyes and related compounds conducted with a hope to obtain some information regarding the structures of sulphur dyes. The attempts made include successful preparations of four new sulphur dyes, trials to degrade S-Black T molecule, an attempt to show the presence of primary amine group ($-NH_2$) in S-Black T, etc. The observations made in some of these experiments are insufficient to arrive at any conclusions and perhaps their chief value is to pave the way for future investigations.

104 pages. $1.30. MicA 55-937

THE REACTION OF cis-α-DECALONE AND trans-α-DECALONE WITH DIAZOMETHANE

(Publication No. 11,569)

Hugo Heinrich Peter, Ph.D.
Washington University, 1955

Chairman: C. David Gutsche

cis-α-Decalone and trans-α-decalone have been prepared in high purity by modifications of known methods including a novel and convenient synthesis of 5,6,7,8-tetrahydronaphthol-1 and certain improvements in the catalytic hydrogenation of α-naphthol. Also, cis- and trans-α-hexahydrobenzosuberone and cis- and trans-β-hexahydrobenzosuberone, the expected products of diazomethane ring enlargement of cis- and trans-α-decalone, have been prepared by unequivocal means. The epoxide formed in the reaction between diazomethane and trans-α-decalone was isolated as a mixture of known purity, and the product of further ring expansion, hexahydrobenzocycloöctanone, was isolated from reaction mixtures in which an excess of diazomethane had been employed. With these compounds available it has been possible to devise an analytical scheme based on infrared methods whereby the amounts of the various products formed in the reaction between the α-decalones and diazomethane can be established.

The effect of changes in various reaction conditions has been studied. Variations in temperature,

solvent, concentration, type of base, and mode of generation of the diazomethane have been shown to exert an influence on the reaction by altering either or both the extent of the reaction and the ratios between the several products formed. These findings are in contrast to previous reports in the literature which indicate reactions of this type to be relatively unaffected by such variations. Interesting differences have also been noted between the cis and trans isomer of α-decalone; The trans isomer shows a markedly greater tendency than the cis isomer to form the epoxide upon reaction with diazomethane. The implications of the differences between the cis and trans isomers and of the effect of environmental changes have been discussed in terms of the mechanism of the interaction of carbonyl compounds with diazoalkanes. 160 pages. $2.00. MicA 55-938

EXTENSIONS OF THE RAMBERG AND BÄCKLUND REACTION

(Publication No. 11,432)

Frank Scholnick, Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. Marvin Carmack

In 1940, Ludwig Ramberg and Birger Bäcklund noted that α-halo sulfones react with aqueous alkali to form olefins. For example, α-bromoethyl ethyl sulfone yields butene-2 on treatment with potassium hydroxide. Although the mechanism of the reaction was subsequently studied, and applied to several additional sulfones, no further use has been made of this unusual reaction.

In this investigation, the reaction has been extended to various types of α-halo sulfones and applied to a number of hitherto unprepared α-halo sulfones.

(1) Reaction of β-benzylsulfonyl-β-bromopropionic acid and α-benzylsulfonyl-α-bromopropionic acid with sodium hydroxide leads to the formation of the unsaturated acids, β-benzal-propionic acid and α-benzal-propionic acid respectively.

(2) The reaction may be applied to a compound containing two α-halo sulfone groups within the molecule and leads to formation of a diolefin. Thus, α,α′-bis (benzylsulfonyl) α,α′-dibromobutane yields bicinnamyl.

(3) Sulfones with two halogen atoms on the alpha carbon atom form acetylenes on treatment with sodium hydroxide. For example, benzyl dibromoethyl sulfone gives phenylacetylene when heated with alkali. Experimental evidence suggests that styrene is also formed in the above reaction.

60 pages. $1.00. MicA 55-939

THE ACTION OF GRIGNARD REAGENTS ON HINDERED KETONES VINYLATED IN A CONJUGATE POSITION

(Publication No. 11,541)

Shaler Gordon Smith, Jr., Ph.D.
University of Illinois, 1955

Because both ortho- and para-alkylation of hindered ketones of the type represented by benzoyldurene have been accomplished through the use of Grignard reagents, (1,2,3,4) attention was turned to systems containing a vinyl group in a conjugate position. 5-Mesitoylacenaphthylene, which contains the olefinic peri-bridge in a conjugate position, was investigated. (5) Grignard reagents were found to combine with this compound, but the products appeared to be polymers. However, 1,8-addition was obtained with this system when a reagent of lower nucleophilic potential, ethyl malonate, was used.

Therefore, it would appear that the action of Grignard reagents on hindered ketones vinylated in a conjugate position with a less peculiar olefinic group than the peri-bridge of 5-mesitoylacenaphthylene would be of interest.

The object of the present research was to study the action of Grignard reagents on o-isopropenylbenzoyldurene, p-mesitoylstilbene, and p-isopropenylbenzoyldurene in an effort to determine whether the electrophilic effect of the keto group is strong enough to affect the vinyl side-chain in the presence of Grignard reagents.

It was possible to show that o-isopropenylbenzoyldurene does indeed combine with the t-butyl Grignard reagent in a 1,6-manner. But the point of attachment of the t-butyl group is, significantly, at the para position of the benzene ring rather than in the vinyl side-chain. The structure of the product, 4-t-butyl-2-isopropenylbenzoyldurene, was established by reduction to the isopropyl derivative and independent synthesis of the latter.

p-Mesitoylstilbene was also found to combine with a Grignard reagent; in fact, benzylmagnesium chloride introduced two benzyl groups. It is probable that one benzyl radical entered in a 1,8-conjugate fashion; however, independent synthesis of the product was not realized.

The alkylation of o-isopropylbenzoyldurene by t-butylmagnesium chloride was found to be of preparative value when a procedure involving a short reaction period followed by air oxidation of dihydro intermediates was employed. The para-alkylated product was obtained in one of the highest recorded yields for this type of reaction.

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5. F. E. Mange, Thesis, Doctor of Philosophy, University of Illinois, 1951.

67 pages. $1.00. MicA 55-940

EVIDENCE FOR A DISPLACEMENT REACTION IN THE FRIEDEL-CRAFTS REACTION OF HIGHER ALKYL HALIDES IN AROMATIC SUBSTITUTION

(Publication No. 11,663)

Charles Richard Smoot, Ph.D.
Purdue University, 1955

Major Professor: Herbert C. Brown

The disproportionation of alkylbenzenes under the influence of aluminum bromide and hydrogen bromide has been studied using the homogeneous system of six moles of aromatic per mole of hydrogen bromide-dimeric aluminum bromide (6 Ar:HBr:Al_2Br_6) at 0°. The alkylbenzenes were converted to benzene, di- and trialkylbenzenes in a series of reversible reactions. The equilibrium concentrations were determined and apparent equilibrium constants calculated for the disproportionations of ethyl-, n-propyl-, isopropyl- and t-butylbenzenes; under the same conditions, toluene was recovered unchanged. The rates at which equilibria are attained were determined with ethyl- and isopropylbenzenes at 0°. The order of migratory aptitudes for alkyl groups is t-butyl > isopropyl > ethyl > methyl. A mechanism is proposed which involves a nucleophilic displacement by an aromatic on a highly reactive π-complex, which is in mobile equilibrium with a stable σ-complex of the alkylbenzene undergoing disproportionation.

A kinetic study of the gallium bromide catalyzed alkylation of benzene and toluene with methyl, ethyl and n-propyl bromides was made. A pseudo zero reaction was observed when the alkyl bromide concentration exceeds that of the gallium bromide used as catalyst. The reaction is zero order with respect to alkyl bromide, with mild inhibition at higher concentrations. The reaction is second order with respect to monomeric gallium bromide.

In the reactions of methyl, ethyl and n-propyl bromides with benzene, the relative rates of reaction are 1.00, 33 and 67, with energies of activation being 12.5, 12.4 and 12.9 kcal. $mole^{-1}$, respectively. The entropies of activation for the same reactions are -29.3, -22,6 and -19.2 cal. $mole^{-1}deg.^{-1}$. With toluene the relative rates of reaction of methyl, ethyl, n-propyl, isopropyl and t-butyl bromides are 1.00, 13.7, 15.9, $3x10^5$, and $8x10^5$, respectively, at 25°. The energies and entropies of activation for the reactions of the first three alkyl bromides are 12.0, 12.0 and 11.8 kcal. $mole^{-1}$ and -27.4, -22.2 and -22.7 cal. $mole^{-1}deg.^{-1}$, respectively. These data are consistent with a mechanism which involves a nucleophilic attack by the aromatic on a polarized, highly reactive 1:2 alkyl bromide-gallium bromide addition compound. The data suggest that a partial positive charge is developed at the carbon undergoing attack in the transition state. The ability of the alkyl group to stabilize the partial positive charge influences the rate. With increasing branching of the alkyl group, the reaction undergoes a gradual change in mechanism, with ionization predominating with isopropyl and t-butyl bromides.

The isomer distributions in the gallium bromide catalyzed alkylations of toluene with methyl, ethyl, isopropyl and t-butyl bromides were determined and they were found to be: methylation, 55.7% ortho, 9.9% meta and 34.4% para; ethylation, 38.3% ortho, 21.1% meta and 40.6% para; isopropylation, 26.2% ortho, 26.6% meta and 47.2% para; and t-butylation, 0.0% ortho, 32.1% meta and 67.9% para. By use of the kinetic data and isomer distributions, the "activities" of the reacting species were calculated to be methyl < ethyl < isopropyl > t-butyl. These data exclude the possibility of an ionization mechanism, and are consistent with, and strongly support, the postulation of a displacement reaction in the Friedel-Crafts reaction of primary alkyl halides.

A study of the factors influencing the n- to isopropylbenzene ratio in the alkylation of benzene with n-propyl derivatives was made. The n-propyl derivative, catalyst and aromatic were each varied systematically and the effect on the ratio of the n- to isopropyl groups being introduced determined. The yields of n-propylbenzene in the monopropylbenzene fraction increased steadily in going from n-propyl chloride to n-propyl iodide or in going from aluminum iodide to aluminum chloride. The yields of n-propyl derivative increase rapidly with the use of more basic hydrocarbons. Thus, with p-xylene and mesitylene the yields of n-propyl derivative were 93 and 99%, respectively. A rapid decrease in the n- to iso ratio was observed with increasing temperature. It is postulated that the n- to iso ratio is determined by the relative rates of two concurrent reactions: one, a direct displacement by benzene on the n-propyl halide-metal halide addition compound; and two, an isomerization of the n-propyl halide to isopropyl halide and subsequent alkylation. The data on the factors influencing the n- to iso ratio exclude the possibility of an ionization mechanism, and are entirely consistent with the postulation of a displacement reaction in the Friedel-Crafts reaction of primary alkyl halides. 348 pages. $4.35. MicA 55-941

STUDIES ON THE COMPOSITION OF STARCH HYDROLYSATES AND GLUCOSE REVERSION MIXTURES

(Publication No. 11,574)

Alfred Samuel Spriggs, Ph.D.
Washington University, 1954

Chairman: Associate Professor John C. Sowden

One of the effects of dilute or concentrated hydrochloric acid upon monosaccharides is the formation of

higher saccharides. This process of polymerization or reversion may give rise to a variety of di- and oligosaccharides. In the commercial production of glucose from starch by acid hydrolysis, a sirupy residue known as hydrol remains after the crystallization of the D-glucose. Since the major end product of the hydrolysis of starch by acid is D-glucose, the sugars occurring in hydrol may be hydrolytic products of starch or products of the D-glucose reaction, or both.

In this study, methods are developed and employed for the isolation and characterization of the carbohydrate constituents of hydrol and of complex mixtures formed by the action of aqueous hydrochloric acid on D-glucose. The methods utilized were those of carbon-Celite column chromatography, silicate column chromatography, and paper chromatography. Radioisotopic dilution analysis is applied to determine the concentration of D-glucose and gentiobiose in the starch hydrolysate.

The D-glucose and gentiobiose content of a representative sample of hydrol were determined by radioisotopic dilution analysis. The D-glucose content (65%) determined by this method is in close agreement to that obtained elsewhere by direct isolation of the sugar from hydrol. In contrast, the gentiobiose content (9%) as determined by the present method is considerably greater than previously reported.

In addition to gentiobiose, the following disaccharides were isolated from hydrol by means of carbon-Celite chromatography, and their per cent in hydrol estimated: isomaltose (9.7%), 5-β-D-glucopyranosyl-D-glucose (0.9%), and β-cellobiose (0.4%). The amount of unidentified higher oligosaccharides was estimated to be 3.9%. 5-β-D-Glucopyranosyl-D-glucose was characterized as its crystalline p-toluenesulfonylhydrazone. The non-crystalline octaacetate of this sugar was also prepared.

The extent and nature of the products formed by the action of aqueous hydrochloric acid on D-glucose have been examined. The following components, which were isolated either as the free sugar or as their octaacetates by application of carbon-Celite or Magnesol-Celite chromatography, were separated from the D-glucose reversion mixture: D-glucose (ca. 71%), β-maltose hydrate (ca. 1.5%), α,α-trehalose dihydrate (ca. 1%), isomaltose (ca. 5%), gentiobiose (ca. 4%), 5-β-D-glucopyranosyl-D-glucose (ca. 0.1%), β-cellobiose (ca. 1.5%), and higher oligosaccharides (ca. 7%). It is demonstrated that these di- and oligosaccharides constituents of hydrol may be formed by the reversion process in the manufacture of glucose.

104 pages. $1.30. MicA 55-942

THE STEREOCHEMISTRY OF 5,6-DIHYDRO-4H-PHENANTHR(c,d,e)AZEPINE DERIVATIVES

(Publication No. 11,438)

Fred Wilbur Stone, Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. Marvin Carmack

This study involves the preparation of a series of 5-substituted 5,6-dihydro-4H-phenanthr(c,d,e)azepines and an attempt to determine whether or not the molecules are dissymmetric.

The preparation of three previously unknown amines, 5,6-dihydro-5-phenyl-, 5,6-dihydro-5-(p-methoxyphenyl)-, and 5,6-dihydro-5-butyl-4H-phenanthr(c,d,e)azepine was achieved. The synthetic route employed involved the ozonolysis of pyrene to yield 4,6-dihydro-6-hydroxyphenanthr(c,d,e)oxepin-4-one. This compound, or its methyl ester, was then reduced to 4,5-bis-(hydroxymethyl)phenanthrene which was converted to 4,5-bis-(bromomethyl)phenanthrene by the action of phosphorous tribromide. The dibromo compound was then easily converted to the fused heterocyclic system by condensation with the appropriate primary amine (i.e., aniline, p-anisidine, and n-butylamine). The methiodides and picrates of the phenanthr(c,d,e)azepines were also prepared.

Attempted resolutions of the 5-substituted 5,6-dihydro-4H-phenanthrenes by the preparation of salts with optically active acids, by chromatographic absorption on an optically active absorbent and by the preparation of a salt of the methiodide of the 5-phenyl compound with an optically active acid failed to give conclusive evidence that the amines were dissymmetric.

Although failure to resolve a compound into its optically active forms does not constitute proof that they do not exist, this fact, associated with the physical evidence derived from a study of the ultraviolet and infrared spectra of these and related compounds, is more conclusive. It is highly probable that either the molecules in question show such a low order of optical stability that resolution is rendered exceedingly difficult, or the inherent strain is compensated for in a manner not leading to dissymmetry.

84 pages. $1.05. MicA 55-943

THE PREPARATION OF CERTAIN FLUOROOLEFINS CONTAINING THE TRIFLUOROMETHYL GROUP

(Publication No. 11,484)

Robert Edward Taylor, Ph.D.
The University of Florida, 1955

Hydrocarbon esters of perfluorocarboxylic acids have been prepared by the pyrolysis of a silver salt of a perfluorocarboxylic acid in the presence of an olefin.

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For example: pyrolysis of silver trifluoroacetate in the presence of butene-2 gave sec-butyl trifluoroacetate. This is a new and unexpected reaction of silver salts of perfluorocarboxylic acids. The results of this work indicate that the stability of the perfluoroacyloxy radical is considerably greater than previously supposed.

A study has been made of the preparation of 2-trifluoromethylbutadiene-1, 3 from trifluoroacetone. Two diverse methods have been found. The first procedure involves the preparation of a cyanohydrin which is in turn converted to a keto-alcohol by reaction with methylmagnesium bromide. Subsequent reduction of the carbonyl group and dehydration yielded the desired diene. The second procedure requires the preparation of 3-trifluoromethylcrotonic acid which may be reduced to a primary alcohol and dehydrated to 2-trifluoromethylbutadiene-1, 3.

Several trifluoromethyl-containing styrenes have been prepared by reaction of an aryl Grignard reagent and trifluoroacetone followed by dehydration of the intermediate carbinols. The effect of trifluoromethyl groups on hydrogen bonding and the effect of hydrogen bonding on boiling points and infrared spectra is discussed.

The following new compounds have been prepared and characterized: 2-trifluoromethyl-2-hydroxybutanone-3, 2-trifluoromethylbutanediol-2, 3, 3-trifluoromethyl-2-buten-1-ol, 3-trifluoromethyl-α-methyl-α-trifluoromethylbenzyl alcohol, 3-trifluoromethyl-α-trifluoromethylstyrene, 3, 5-bis(trifluoromethyl)-α-methyl-α-trifluoromethylbenzyl alcohol, 3, 5-bis(trifluoromethyl)-α-trifluoromethylstyrene and 3-trifluoromethylbenzyl alcohol.

79 pages. $1.00. MicA 55-944

CHEMISTRY, PHARMACEUTICAL

A STUDY OF PYRETHRUM AND ITS ACTIVATORS

(Publication No. 11,489)

Murray Sheldon Blum, Ph.D.
University of Illinois, 1955

The ability of piperonyl butoxide to synergize pyrethrum when applied after the insecticide has been determined. A large dose of synergist (10 ug.) is much more effective than a small dose (1 ug.) in this respect. Since the rate of penetration of compounds throught the cuticle is concentration dependent, this is interpreted to mean that larger doses of the synergist permit the activator to obtain critical sites while the pyrethrum is still effective. This hypothesis is supported by the fact that injected doses of synergist are more effective than topical doses when the synergist is applied after the insecticide.

The relation between the nature of the side chain of synthetic pyrethrin-like esters and the toxicity and synergistic response of these compounds was determined. Natural pyrethrum was the most highly synergized compound tested. Esters with olefin side chains in the alcohol portion of the molecule were found to be the most toxic and most highly synergized of the synthetic esters. Esters with heterocyclic side chains were less toxic and less synergized than the closely related homocyclic compounds. The introduction of chlorine into the side chain of the alcohol portion of the molecule reduces toxicity and diminishes synergistic response. Benzyl, when compared to phenyl as a side chain substituent, is more toxic and responds better to pyrethrum synergists.

Lethal doses of pyrethrum seriously distort the normal spontaneous activity patterns of houseflies. A mixture of pyrethrum and piperonyl butoxide causes a pattern which is similar to that obtained with a lethal dose of pyrethrum.

A colorimetric test for all synergists containing the methylenedioxyphenyl radical has been developed. Using this test to study the distribution of a synergist in a roach, it has been determined that the synergist accumulates in the central nervous system after injection, topical, and oral administrations.

The negative temperature coefficient of pyrethrum in the roach is associated with the presence of a blood-borne toxin which may not be pyrethrum. At 35°C, the blood is non-toxic, while at 15°C, the presence of a toxin is demonstrated by injecting Sarcophagid flies with the blood. Piperonyl butoxide interferes with the ability of the roach to tolerate pyrethrum at 35°C. The toxic material is unstable at room temperature and cannot be dialyzed out of the blood.

Employing C^{14} pyrethrum, the metabolism of the insecticide has been studied in the housefly. Detoxication appears to be associated with the production of an alcohol soluble metabolite. Piperonyl butoxide inhibits the formation of this material. Hydrolysis does not appear to be the main avenue to pyrethrum detoxication since the amount of free acid does not increase eight hours after treatment with pyrethrum.

96 pages. $1.20. MicA 55-945

ANTISPASMODICS. BASIC-ALKYL ESTERS OF β-SUBSTITUTED α-PHENYL- AND α-CYCLOHEXYL-β-HYDROXYPROPIONIC ACIDS

(Publication No. 11,261)

Robert Hames Cox, Ph.D.
University of Illinois, 1955

The object of this investigation was to prepare basic esters of β-substituted α-phenyl- and α-cyclohexyl-β-hydroxypropionic acids in order that they might be tested for antispasmodic activity.

α-Phenyl-β-hydroxypropionic acid (tropic acid) and twenty β-substituted α-phenyl-β-hydroxypropionic acids, six of them new, were prepared from phenylacetic acid and the required aldehyde or ketone by means of the Ivanov procedure. These α-phenyl-β-hydroxypropionic acids conformed to the general

formula $C_6H_5CH(RR'COH)COOH$. R was H, CH_3, C_2H_5, C_3H_7; R' was H, CH_3, C_2H_5, C_3H_7, C_5H_{11}, C_6H_{13}, C_6H_5, 4-$CH_3OC_6H_4$, 2-C_4H_3S. RR' also represented $-CH_2(CH_2)_3CH_2-$, $-CH(CH_3)(CH_2)_3CH_2-$, $-CH_2CH(CH_3)(CH_2)_2CH_2-$, $-CH_2CH_2CH(CH_3)CH_2CH_2-$, $-CH_2(CH_2)_5-CH_2-$. Basic esters of the previously reported α-phenyl-β-hydroxypropionic acids in this series had in most instances already been disclosed. However, we wished to hydrogenate these acids to obtain the unknown β-substituted α-cyclohexyl-β-hydroxypropionic acids, basic esters of which could then be prepared for pharmacological testing.

In addition to α-cyclohexyl-β-hydroxypropionic acid, sixteen new β-substituted α-cyclohexyl-β-hydroxypropionic acids were prepared by catalytic hydrogenation of the required α-phenyl-β-hydroxypropionic acids. These acids conformed to the general formula $C_6H_{11}CH(RR'COH)COOH$. R was H, CH_3, C_2H_5, C_3H_7; R' was H, CH_3, C_2H_5, C_3H_7, C_5H_{11}, C_6H_{11}, C_6H_{13}. RR' was also $-CH_2(CH_2)_3CH_2-$, $-CH_2CH(CH_3)-(CH_2)_2CH_2-$, $-CH_2CH_2CH(CH_3)CH_2CH_2-$, $-CH_2(CH_2)_5-CH_2-$.

Four α-phenyl-α-cycloalkylideneacetic acids, three of them new, were prepared by dehydration of the required α-phenyl-α-(1-hydroxycycloalkyl)acetic acids (α-phenyl-β,β-polymethylene-β-hydroxypropionic acids). The ultraviolet absorption spectrum of each of the new acids was essentially coincident with the spectrum of the known acid, α-phenyl-α-cyclohexylideneacetic acid, which indicated that these new acids had the α-phenyl-α-cycloalkylidene structure.

In addition to the foregoing series of acids, the following miscellaneous acids were prepared: the known acids, α-phenylacrylic (atropic) and β,β-diphenyl-β-hydroxypropionic, and the new acids, β,β-dicyclohexyl-β-hydroxypropionic and α-phenyl-α-(1-hydroxycyclohexyl)butyric.

All basic esters prepared for pharmacological testing were obtained by reacting the required acid and tertiary aminoalkyl halide in isopropyl alcohol according to the directions of Horenstein and Pahlicke. The hydrochlorides and methobromides of the β-diethylaminoethyl esters of α-cyclohexyl-β-hydroxypropionic acid, the sixteen β-substituted α-cyclohexyl-β-hydroxypropionic acids, and eight of the β-substituted α-phenyl-β-hydroxypropionic acids, were prepared; the corresponding ester salts of α-phenyl-α-(1-cyclohexenyl)acetic acid, β,β-diphenyl-β-hydroxypropionic acid and β,β-dicyclohexyl-β-hydroxypropionic acid were also synthesized. In the case of α-cyclohexyl-α-(1-hydroxycyclohexyl)acetic acid, salts were prepared of other basic esters in addition to the β-diethylaminoethyl ester (viz., the β-piperidinoethyl and γ-dimethylaminopropyl esters). In the case of β-diethylaminoethyl α-phenyl-α-(1-hydroxycyclohexyl)acetate, several other quaternary bromides besides the methobromide were synthesized (viz., C_2H_5Br, $CH_2{:}CHCH_2Br$, $C_6H_5CH_2Br$, $C_6H_5COCH_2Br$).

The effect of aqueous alkali on each of a selected group of β-substituted α-phenyl-β-hydroxypropionic acids, and on each of the corresponding α-cyclohexyl-β-hydroxypropionic acids, was studied. Under the relatively mild experimental conditions employed, the β-substituted α-phenyl-β-hydroxypropionic acids were cleaved to phenylacetic acid and a carbonyl compound; on the other hand, their α-cyclohexyl analogs were recovered essentially unchanged. This cleavage of the C_α-C_β bond was also observed when methyl α-phenyl-α-(1-hydroxycycloalkyl)acetates were treated with an excess of ammonia or hydrazine monohydrate, in which case phenylacetamide or phenylacethydrazide, respectively, was obtained.

The principal literature data which are concerned with cleavage of the C_α-C_β bond of β-hydroxy acids and esters have been briefly summarized in this discussion. The literature data, together with our observations, suggest that essentially all β-hydroxy acids and their esters can undergo cleavage of the C_α-C_β bond, and that such cleavage is base-catalyzed. Molecular structure is seen to have a very great effect on the rate of cleavage. A mechanism is postulated for base-catalyzed cleavage which involves proton-removal from the β-hydroxyl group, with subsequent cleavage of the C_α-C_β bond of the anion so formed. The postulated mechanism appears to be consistent with the available experimental data.

121 pages. $1.51. MicA 55-946

DERIVATIVES OF PARAXANTHINE AND A STUDY OF REACTIONS OF 1,3-DIMETHYL-5,6-DIAMINOURACIL

(Publication No. 11,283)

Henry Charles Godt, Jr., Ph.D.
University of Michigan, 1954

The object of this investigation was the preparation of new xanthines and related compounds in the hope that active diuretics might be discovered which would prove satisfactory for clinical use.

Thirteen 3-substituted paraxanthines were synthesized by the alkylation of paraxanthine. The 3-ethyl derivative is the only compound which had been prepared previously. In view of the fact that paraxanthine was obtained by a known synthesis which involved the use of imidazoles, we investigated the preparation of several new imidazoles in the hope that the latter compounds might be of use in the preparation of xanthines or compounds closely related to them. The new imidazoles that were synthesized by us were 1-methyl-4-nitro-5-benzylcarbamylimidazole, 1-methyl-4-amino-5-benzylcarbamylimidazole hydrochloride, 1-methyl-4-nitro-5-isopropylcarbamylimidazole, 1-methyl-4-nitro-5-β-chloroethylcarbamylimidazole, 1-methyl-4-nitro-5-aminoimidazole and diethyl 5-(1-methyl-4-nitroimidazolyl)-malonate. We were unable to utilize these compounds for the purpose mentioned above.

When diethyl 5-(1-methyl-4-nitroimidazolyl)malonate was hydrolyzed under acidic conditions, in an attempt to prepare the corresponding 5-imidazolylacetic acid, complete decarboxylation took place which resulted in the formation of 1,5-dimethyl-4-nitroimidazole in 80% yield. This process represents the best procedure for the synthesis of this imidazole.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

Five 8-basically-substituted caffeines, only one of which had been previously prepared, were synthesized by amination processes carried out on 8-chlorocaffeine. Also eighteen 3-alkyl-8-chloroparaxanthines and 3-alkyl-8-basically-substituted paraxanthines were prepared from 8-chloroparaxanthine by alkylation and amination processes. Only two of these 3,8-disubstituted paraxanthines had been synthesized previously.

By the condensation of various reagents with 1,3-dimethyl-5,6-diaminouracil, several compounds closely related to theophylline were prepared. These substances included 4,6-dimethyl-5,7-diketo-4,5,6,7-tetrahydro-1-v-triazolo[d]pyrimidine and its 1(2 or 3)-acetyl and 1(2 or 3)-benzoyl derivatives, 4,6-dimethyl-5,7-diketohexahydropyrimido(4,5-c)(1,2,5)-thia diazole and 1,3-dimethyllumazine together with five of its derivatives. Lumazine is a common name for 2,4-dihydroxypteridine. It was also found that 1,1′,3,3′-tetramethylhydurilic acid was formed by refluxing 1,3-dimethyl-5,6-diaminouracil in dilute hydrochloric acid.

More than fifty-five compounds were submitted for pharmacological evaluation. So far only twenty-one have been tested for diuretic activity. It was found that several of these compounds produced moderate diuresis in dogs.

124 pages. $1.55. MicA 55-947

POLYCYCLIC QUATERNARY AMMONIUM SALTS

(Publication No. 11,296)

Eric Bell Hotelling, Ph.D.
University of Michigan, 1954

During recent years two relatively simple quaternary ammonium compounds, which can be synthesized readily, have aroused wide pharmacological and clinical interest. One of these compounds is hexamethonium chloride (hexamethylene-1,6-bistrimethylammonium dichloride), which has found application in certain types of hypertension. The other is decamethonium bromide (decamethylene-1,10-bistrimethylammonium dibromide), which has been used as a muscle relaxant in place of the complex alkaloid d-tubocurarine.

Although a large number of bisquaternary compounds have already been prepared and studied in other laboratories, the object of this investigation was the synthesis of additional numbers and varieties of compounds of the quaternary type; it was hoped that active products might be found which would be more suitable for therapeutic use.

During this investigation 96 quaternary compounds have been prepared; 88 of them are new products. Most of the compounds can be arranged in six groups:

1. N,N,N′,N′-Tetrasubstituted ethylenediamines
2. Alkyl and allyl bisquaternary salts of N,N,N′,N′-tetrasubstituted polymethylenediamines
3. Bicyclic spirobisquaternary salts
4. Tricyclic dispirobisquaternary salts
5. Bicyclic spiroquaternary salts
6. Tricyclic spiroquaternary salts

The bis-tertiary bases in group 1 were prepared by condensation of an N-(β-chloroethyl)amine, such as N-(β-chloroethyl)piperidine, with a cyclic imine such as morpholine or a polymethylenimine. Addition of methyl, ethyl or allyl bromide to the bases of group 1 produced the bisquaternary salts of group 2. Condensation of the bases of group 1 with either ethylene bromide or trimethylene bromide resulted in the formation of the bicyclic spirobisquaternary and tricyclic dispirobisquaternary salts of groups 3 and 4.

The bicyclic spiroquaternary salts of group 5 were obtained from polymethylenimines or morpholine by condensation with tetramethylene, pentamethylene or hexamethylene bromide in the presence of alkali. When the same polymethylenimines were treated with o-xylylene bromide and alkali, the tricyclic spiroquaternary salts of group 6 were formed.

In addition to the compounds mentioned, four bisquaternary salts of 4,4′-bipiperidine, two of which were tetracyclic, were also prepared. They were obtained by catalytic reduction of 4,4′-bipyridyl dihydrochloride or dimethobromide, followed by addition of methyl bromide or allyl bromide, or reaction with tetramethylene bromide or pentamethylene bromide. All of these compounds bear a rather close resemblance to hexamethonium.

209 pages. $2.61. MicA 55-948

ANALOGS OF EPINEPHRINE

(Publication No. 11,302)

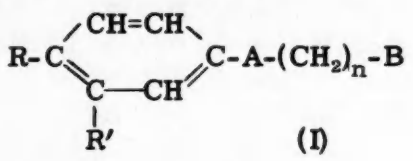
William K. Johnson, Ph.D.
University of Michigan, 1954

At certain times in the past, it must have seemed that in view of the excellent therapeutic properties of such drugs as epinephrine, barbital and procaine, the preparation of numerous homologs and analogs of these substances could be productive of nothing other than a needless duplication of compounds. However, in all three instances, detailed pharmacological and clinical studies of substances which differ in structure, often only slightly, from the prototypes have led to the introduction of many new drugs which, for certain specific purposes, often far surpass the original drug in usefulness.

This investigation was undertaken in the hope that the synthesis and pharmacological study of additional analogs of epinephrine might disclose products which possess advantages over the drugs now in use and which would increase the already wide range of usefulness of medicaments of the epinephrine type.

The products which have been prepared will be evaluated pharmacologically in The Upjohn Company laboratories but, so far, no pharmacological report has been received.

Eighteen new products which conform to the following general formula were prepared:



(I)

R and R′ = H, OH or CH_3
A = CO, CH(OH), $CH(OCH_3)$ or $CH(OC_2H_5)$
n = 1 or 2
B = $NH(CH_3)$, $N(CH_3)_2$, $N(CH_3)(CH_2C_6H_5)$, $N<(CH_2)_6$ or $N<(CH_2)_7$

These products were characterized as hydrochlorides, hydrobromides or methobromides.

Fifteen new products, which may be represented by the general formula $RCH_2CH(R')NR''R'''$ (II) were also synthesized. In this formula R represents cyclohexyl, cycloheptyl, 1-cycloheptenyl, 4-methylcycloheptyl or cyclooctyl; R′, R″ and R‴ represent a hydrogen atom or a methyl group. These compounds were isolated as bases and as hydrochlorides or hydrobromides.

Compounds of the general type I (n = 1) were obtained by condensation of a substituted phenacyl halide with the required amine; other compounds (n = 2) were synthesized by the use of the Mannich reaction. The products which contained carbonyl groups were reduced catalytically, with the aid of platinum oxide, to the corresponding ketones.

In order to synthesize compounds of type II, the required ketone was treated with formamide and formic acid (Leuckart reaction). The N-formyl derivative obtained was (a) hydrolyzed to the primary amine; (b) reduced with lithium aluminum hydride to the secondary amine. In some instances the primary amine was converted into the corresponding dimethylamino derivative by the use of formaldehyde and formic acid.

Quaternary salts of amines of types I and II were obtained either by interaction of a phenacyl halide with a tertiary amine or by quaternization of a tertiary amine with methyl bromide.

Two additional amines, 1-methyl-2-aminocyclohexane and 1-methyl-2-methylaminocyclohexane, were prepared from 2-methylcyclohexanone with the aid of the Leuckart reaction. The product obtained from the latter reaction was (a) hydrolyzed to form the primary amine, and (b) reduced with lithium aluminum hydride to yield the secondary amine.

140 pages. $1.75. MicA 55-949

THE SYNTHESIS AND EVALUATION OF SOME STEROID EMULSIFYING AGENTS

(Publication No. 11,357)

Joseph Eugene Sinsheimer, Ph.D.
University of Michigan, 1954

The purpose of this investigation is to study the nature of the emulsifying ability of sterols. More specifically, the ability of normal esters of 3α-carboxy-Δ^5-cholestene, normal esters of 3α-(hydroxymethyl)-Δ^5-cholestene and steroid hydroxystearic acid esters to increase the emulsifying efficiency of cholesterol are studied. A comparison of the emulsifying ability of some derived steroids to that of cholesterol is made.

The general characteristics and development of ointment bases are reviewed. Special attention in this review is given to the relationship of this investigation to the characteristics and constituents of wool wax.

A discussion and description of the synthesis of the following compounds is given: (1) 3α-carboxy-Δ^5-cholestene and fifteen of its normal esters, (2) 3α-(hydroxymethyl)-Δ^5-cholestene and nine of its normal esters, (3) the 12-hydroxystearic acid esters of cholesterol and of 3α-(hydroxymethyl)-Δ^5-cholestene and (4) the 9,10-dihydroxystearic acid ester of 3α-(hydroxymethyl)-Δ^5-cholestene.

In the process of evaluating the emulsifying efficiencies of these compounds and their ability to potentiate the emulsifying efficiency of cholesterol, there is demonstrated the necessity of developing a testing procedure to which an application of a statistical evaluation of the results could be made. Recognition is made of the nature of the quantal response occurring in the application of the Powers-Cataline method of comparing emulsifying systems. The similarity of this quantal response to that found in regard to the action of drugs and their responses is established. A statistical method developed to make possible quantitative comparison of drug potency is then applied to the comparison of emulsifying systems.

It is concluded that the ability of the normal esters of 3α-carboxy-Δ^5-cholestene to enhance the emulsifying efficiency of cholesterol in petrolatum is similar to that of the cholesteryl esters. The same conclusion was reached for the normal esters of 3α-(hydroxymethyl)-Δ^5-cholestene. The steroid hydroxystearic acid esters are less efficient than the corresponding stearic acid esters in their ability to potentiate the emulsifying efficiency of cholesterol in petrolatum. Cholesterol is found to be the most efficient of the steroids evaluated. The efficiencies of the others are in the following order: 3α-(hydroxymethyl)-Δ^5-cholestene, epicholesterol and 3α-carboxy-Δ^5-cholestene.

109 pages. $1.36. MicA 55-950

AN ASSAY METHOD FOR PAPAIN USING A SYNTHETIC SUBSTRATE

(Publication No. 11,359)

Louis Benjamin Stadler, Ph.D.
University of Michigan, 1954

The purpose of this investigation is to develop a new assay for papain by measuring its ability to liberate ammonia from a synthetic substrate. This is accomplished by allowing papain to act upon an acylated amino acid and measuring the ammonia liberated by use of Nessler reagent.

A brief description of the papaya tree and the methods of collection and preparation of papain are included. A summary of enzymatic activities and their application to methods of assay of papain and a short discussion of the uses of papain are also given.

An attempt was made to prepare and use several acylated amino acid amides as substrates for papain. Hippuryl amide proved to be most satisfactory for use in the proposed method of assay. The results of a study made of the liberation, collection, and determination of ammonia and of the various factors influencing papain hydrolysis of hippuryl amide are presented.

The proposed method of assay compares hydrolysis of hippuryl amide by a papain standard and the papain sample being tested. Samples used included a number of commercial papain samples and mixed papain preparations such as tablets, powders, and solutions, which contained widely varying amounts of papain. Results of the assay are expressed as percentage activity of the sample based upon N.F. Reference Papain.

A comparison is made between the proposed hippuryl amide method and beef assay methods. Results expressed as percentage activity based upon N.F. Reference Papain seem to be the same whether found by beef digestion or by hippuryl amide splitting. The latter gives more precise results, is more flexible with respect to the type of papain preparations which can be tested and has the advantage of reproducibility of different lots of substrate. The use of a Reference papain is recommended in the routine assay of papain although the assay may be carried out without such a standard if less precision is acceptable. Elimination of a Reference papain standard is accomplished by establishing a purity rubric based upon the amount of nitrogen liberated as ammonia from hippuryl amide by papain under specified conditions.

120 pages. $1.50. MicA 55-951

CHEMISTRY, PHYSICAL

AN ADIABATIC SPECIFIC HEAT CALORIMETER FOR THE TEMPERATURE RANGE OF 4°K TO 15°K: THE ATOMIC HEAT OF TITANIUM

(Publication No. 11,578)

Manuel Aven, Ph.D.
University of Pittsburgh, 1955

The object of this project was to design and construct an adiabatic specific heat calorimeter for the temperature range of 4°K to 15°K, and to obtain the atomic heat of titanium in this temperature range.

The temperature measuring device used in the calorimeter is a constant volume helium gas thermometer. The gas thermometer consists of the thermometer bulb, the manometer for the measurement of pressure, and the tube interconnecting the thermometer bulb and the manometer. The gas thermometer bulb is a cylindrical copper can suspended by two thin monel tubes. The sample under investigation is placed into the thermometer bulb, which thus also acts as a sample container, the volume of the bulb not occupied by the sample being approximately 25 cubic centimeters. The entry of extraneous heat to or the loss of any of the measured heat from the sample is prevented by an adiabatic shield surrounding the sample container. During the measurements the temperature of the adiabatic shield is kept as close as possible to that of the sample container, the temperature difference being indicated by a cobalt-gold to silver-gold thermocouple. The volume of the gas thermometer system is kept constant by a device that automatically adjusts the level of the mercury in the arm of the manometer connected to the thermometer tube. The scale of the manometer can be read directly in millimeters to five significant figures. The cooling of the sample to the experimental temperature is accomplished by circulating cold helium gas through a small chamber on the top of the sample container by means of monel tubes passing through liquid helium. As the cooling proceeds, some of the circulated helium liquefies in the tubes and drops into the chamber, producing further cooling. Before starting the heat capacity determinations the liquid helium is pumped out of the liquefaction chamber.

The calorimeter was used to measure the atomic heat of titanium. At sufficiently low temperatures the atomic heat of a metal can be expressed by the equation

$$C = \gamma T + \frac{1943}{\theta^3} T^3 \text{ joule/deg g-atom}$$

where C is the atomic heat, T is the temperature, θ is the Debye characteristic temperature and γ is a constant. The atomic heat data obtained for titanium obeyed this relationship in the temperature range of 4°K to 13°K. Above 13°K a slight departure from the above equation became noticeable, indicating that θ was decreasing. The constants γ and θ, evaluated by the least squares method using atomic heat data obtained between 4°K and 13°K, were

$$\gamma = (3{,}29 \pm 0.04) \times 10^{-3} \text{ joule/deg}^2 \text{ g-atom}$$
$$\theta = 423 \pm 2 \text{ °K.}$$

78 pages. $1.00. MicA 55-952

A THERMODYNAMIC STUDY OF THE SYSTEM AMMONIUM MONOHYDROGEN DIFLUORIDE - AMMONIUM FLUORIDE

(Publication No. 11,243)

Edwin Benjamins, Ph.D.
University of Michigan, 1954

The heat capacity of a pure anhydrous sample of ammonium fluoride has been determined from 10°K to 300°K. Previously reported anomalies in the heat capacity in the region of 250°K do not exist. The molal entropy at 298.16°K is $17.201 \pm .03$ cal. deg.$^{-1}$.

The phase studies for the binary system NH_4HF_2 - NH_4F have been made by differential thermal analysis. The system is of the simple eutectic type with a eutetic temperature of 109°C. Solid NH_4HF_2 dissociates stoichiometrically whereas the dissociation of NH_4F is accompanied by the formation of a second solid phase.

Dissociation pressure measurements on NH_4HF_2 and the system NH_4HF_2 - NH_4F have been made from 70°C to 110°C. The best empirical equations representing these data are

$$\text{Log } P = \frac{3{,}427.363}{T} + 1.60995 \text{ Log } T + 5.47746 \quad \text{and}$$

$$\text{Log } P = \frac{-3{,}022.966}{T} + 6.87415 \text{ Log } T - 8.82996,$$

respectively.

These data were analyzed in terms of the temperature dependence of the equilibrium constants involving NH_3 and HF as the gaseous species, and the values were tested by direct analytical determination of the composition of the vapor phase.

The temperature dependence of the free energy yields the enthalpy increments for the following reactions at 298.16°K:

(1) $NH_4HF_2(s) \rightleftharpoons NH_3(g) + 2\ HF(g)$
(2) $NH_4F(s) \rightleftharpoons NH_3(g) + NH_4HF_2(s)$
(3) $NH_4F(s) \rightleftharpoons NH_3(g) + HF(g)$

with values of

$\triangle H_1 = 51.12 \pm .3$ kcal.
$\triangle H_2 = 19.07 \pm .1$ kcal.
$\triangle H_3 = 35.1 \pm .2$ kcal.

These data and the Third law entropies of ammonium fluoride, ammonium monohydrogen difluoride, ammonia, and hydrogen fluoride require the assignment of 2.0 units of residual entropy to ammonium monohydrogen difluoride at 0°K.

76 pages. $1.00. MicA 55-953

LOW TEMPERATURE ATOMIC HEATS OF COPPER, SILVER AND GOLD; AND VANADIUM IN THE SUPERCONDUCTIVE STATE

(Publication No. 11,582)

William Sydney Corak, Ph.D.
University of Pittsburgh, 1955

The experimental determination of the atomic heats of copper, silver, and gold in the temperature range from 1°K. to 5°K. was undertaken with three objectives. The first of these was to repeat the measurements of the atomic heats of copper and silver with the hope of obtaining improved accuracy over the previous data. Improvement over the previous measurements is necessary if any limits are to be placed on the deviations of the experimental temperature dependence of the atomic heats from present-day theory. The second objective was to investigate a recently reported anomaly in the atomic heat of silver. The last objective was to extend the range of experimental data for gold below 15°K., the lowest temperature to which previous data had been obtained.

The determination of the atomic heat of vanadium in the superconductive state was undertaken as a portion of a program to obtain the data necessary for the thermodynamic calculations of the superconductive-normal phase diagram.

The samples used were of the highest chemical purity obtainable and were all annealed in vacuo for periods of time which assured that the samples had a high degree of physical, as well as chemical, purity.

A standard low temperature calorimetric technique was used. The samples were heated electrically, and the current through the heater, the voltage drop across the heater, and the duration of the heating were observed with an accuracy in keeping with the objectives of the investigation. The temperature of the samples during the experiments was observed by the use of an Allen-Bradley carbon composition resistor used as a resistance thermometer. The thermometer was calibrated, for each set of determinations of a specific sample, against the vapor pressure of the liquid helium bath used as the low temperature refrigerant.

It was found that, in the range of temperature investigated, the temperature dependence of the atomic heats of copper, silver, and gold could be expressed as the sum of a term linear in temperature plus one cubic in temperature to within the deviations of the experimental data. (A major portion of the deviations could be ascribed to the uncertainties in the present accepted temperature scale.) The form is thus the same as given by considering the atomic heats of these metals to be the sum of the low temperature terms given by simple free electron theory and lattice theory. The constants of the temperature terms are found, however, to differ from those given by the simple theories. No anomaly was found in the temperature dependence of the atomic heat of silver.

It was found that the temperature dependence of the atomic heat of vanadium in the superconductive state could be expressed as the sum of a cubic temperature term ascribed to the lattice, and an exponential term whose exponent contained a constant and the reciprocal of the absolute temperature.

A consideration of all of the errors involved indicates that the precision of the measured atomic heats on the "agreed 48" temperature scale is one to two per cent between 1.8°K. and 4.4°K., and becomes two to three per cent outside these limits.

99 pages. $1.24. MicA 55-954

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

THE DESIGN, CONSTRUCTION, CALIBRATION, AND EVALUATION OF A HEAT OF SOLUTION AND SPECIFIC HEAT CALORIMETER

(Publication No. 11,583)

John Karl Darin, Ph.D.
University of Pittsburgh, 1955

A calorimeter has been constructed in order to measure specific heats and heats of dilution of liquid solutions. The design was basically a compromise of accuracy with ruggedness and ease of operation. The calorimeter was designed to be operated adiabatically in order to secure several important advantages.

The calorimeter proper, which was separated by an air gap from its shield can, contained provisions for stirring, dilution, heating, and temperature measurement, together with considerable auxiliary equipment. Electrical measurements were made on a White double potentiometer. Electronic units were employed to supply highly regulated D. C. power to the calorimeter heater and to control the temperature gradient across the air gap at a minimum. Thermistors were employed to detect changes in the air gap temperature gradient.

The method of operation of the calorimeter is presented in detail in order to transmit, in so far as possible, a working knowledge to future workers. Although the electronic temperature controller was capable of controlling the air gap temperature gradient at a minimum under steady state conditions, it was necessary to develop procedures whereby reset and anticipatory control functions could be supplied manually.

Calculation procedures, which require a minimum amount of labor without sacrifice of precision, are presented for specific heat and heat of solution runs.

Specific heat and heat of solution data for the system n-propanol - water are presented. These data indicate a precision of measurement to ± five calories, and an accuracy of about ± ten calories.

An analysis of the errors revealed during the calibration of the various functions was used in estimating the maximum total error in the determination of heat capacity and heats of dilution. A maximum error of ten to fifteen calories was indicated.

A study of the maximum errors indicates that reduction of the error might well start with the electrical energy input. The net heat exchange error can be greatly reduced by providing for stirring at a reduced and more constant rate. The error in measurement of temperature change could be greatly reduced by employing the more sensitive thermistor resistance thermometer, especially in the measurement of smaller heat effects.

171 pages. $2.14. MicA 55-955

DYNAMIC PROPERTIES OF TEXTILE FIBRES

(Publication No. 10,886)

Basil Anderson Dunell, Ph.D.
Princeton University, 1949

Considerable interest is attached to the problem of the mechanical properties (dynamic modulus G and dynamic viscosity η) of high polymers subjected to harmonic vibrations of varying frequencies. In particular, it has been observed that $\eta\omega$ is relatively independent of frequency $\omega/2\pi$ over a considerable frequency range (1,2,3,4)*. The question has also arisen as to whether a relationship exists between the dynamic energy losses and static phenomena such as creep.

Kuhn has shown how, in a material for which the creep curve is linear with logarithmic time, one may predict the dynamic losses in free vibration experiments(5). In the course of his theoretical arguments he described the mechanical system approximately in terms of a distribution of relaxation times which is a rectangular function on a logarithmic plot, namely,

$$G(\tau)\, d(\log\tau) = G^0 \quad a < \tau < b$$
$$= 0 \quad a > \tau,\ \tau > b \qquad \text{(i)}$$

This distribution of relaxation times had previously been extensively investigated by Becker for ferromagnetic hysteretic behaviour(6). The same function was also shown to fit stress relaxation data in polyisobutylene (7).

By use of the distribution function (i), the correlation between stress relaxation and dynamic properties is exact and remarkably simple, and is mathematically even more direct than the correlation between creep data and dynamic properties. If stress relaxation is linear when plotted against logarithmic time, the data can be expressed in terms of the distribution function (i), where a and b are respectively smaller than and greater than the smallest and largest recorded times. For dynamic experiments in which $1/b \ll \omega \ll 1/a$, the following very simple relationship exists:

$$\eta\omega = \frac{\pi}{2\epsilon_0 \log_e 10} \quad \begin{matrix}\text{(slope of relaxation curve} \\ \text{plotted vs. } \log_{10} \text{ time)}\end{matrix} \qquad \text{(ii)}$$

where ϵ_0 is the fixed strain at which the stress relaxation measurement is being carried out.

This relationship was applied to stress relaxation data(8) for rubbers, and the predicted values of $\eta\omega$ were compared with observed values of $\eta\omega$ for the same rubber stocks(3). Also experimental data were obtained for stress relaxation and dynamic properties of various textile fibres, and comparison between $\eta\omega$ values predicted from equation (ii) and observed values was made. These comparisons are shown in Table A. It is clear from this table that an order of magnitude agreement exists between the observed and calculated values. In most cases, the losses predicted from stress relaxation data are less than the observed dynamic losses.

136 pages. $1.70. MicA 55-956

*References in the abstract are numbered independently of those in the main text.

EXCHANGE REACTIONS BETWEEN Tris(2,2′-dipyridyl)osmium(II) AND (III) IONS AND Tris(1,10-phenanthroline)iron(II) AND (III) IONS

(Publication No. 11,557)

Eugene Eichler, Ph.D.
Washington University, 1955

Chairman: Dr. Arthur C. Wahl

Electron transfer exchange reactions between $Os(dipy)_3^{+2}$ and $Os(dipy)_3^{+3}$ (dipy = 2,2′-dipyridyl) and between $Fe(phen)_3^{+2}$ and $Fe(phen)_3^{+3}$ (phen = 1,10 phenanthroline) were studied in aqueous solution. In addition, new oxidation-reduction reactions involving $Os(dipy)_3^{+2}$ and $Fe(phen)_3^{+2}$ were investigated.

Both isotopic and optical-activity methods were used in studying the exchange reactions. In all of the isotopic experiments approximately 100% exchange was observed. If it is assumed that no zero-time exchange occurred, i.e., no exchange occurred during the separation process, and that the reactions obey a second-order rate law, the rate constants are $> 3 \times 10^5 M^{-1} sec.^{-1}$ at 0°C.

The assumption of no zero-time exchange was tested by performing heterogeneous and competitive reactions. In heterogeneous reactions the two reactants start in different phases. In competitive reactions the solution of the reactant which does not precipitate is prepared with the precipitating agent. This solution is then mixed with a solution of the other reactant to start the competitive reaction. These experiments showed that the assumption of no zero-time exchange was invalid. However, certain of the experiments resulted in less than 100% exchange. Calculations based on these results indicate that the rate constants are probably $> 10^4 M^{-1} sec.^{-1}$ at 0°C.

The measurement of the rate of the $Os(dipy)_3^{+2}$ - $Os(dipy)_3^{+3}$ reaction by the optical-activity method shows that the rate constant is larger than $\sim 10^3 M^{-1} sec.^{-1}$ This result is in conflict with the results of Dwyer and Gyarfas (Nature, 166, 481 (1950)). Under conditions identical to those used in the experiments described in this thesis, they observed a measurable exchange rate. The results from the optical-activity method as applied to the $Fe(phen)_3^{+2}$ - $Fe(phen_3^{+3}$ exchange reaction show that the rate constant is $> \sim 2 \times 10^2 M^{-1} sec.^{-1}$

The net oxidation-reduction reaction between $Os(dipy)_3^{+2}$ and $Fe(phen)_3^{+3}$ was performed with both racemic mixtures and resolved optically active forms of the complex ions. In addition, reactions between $Os(dipy)_3^{+2}$ and $Fe(dipy)_3^{+3}$, $Os(dipy)_3^{+2}$ and $Ru(dipy)_3^{+3}$, and $Fe(phen)_3^{+2}$ and $Ru(dipy)_3^{+3}$ were also performed. All of these reactions were found to be very rapid by observation of the color change as the reaction proceeded. If the reactions are assumed to obey a second-order rate law, the rate constants are $> 3 \times 10^6 M^{-1} sec.^{-1}$ at 0°C.

The experimental results show that the $Os(dipy)_3^{+2}$ - $Os(dipy)_3^{+3}$ and $Fe(phen)_3^{+2}$ - $Fe(phen)_3^{+3}$ exchange reactions proceed with rates at least as large as those for exchange reactions between the negatively charged complex ions MnO_4^{-2} - MnO_4^- and $Fe(CN)_6^{-4}$ - $Fe(CN)_6^{-3}$, and the results indicate that the reactions between the positive complex ions proceed at much larger rates than the reactions between the negative complex ions.

75 pages. $1.00. MicA 55-957

1. THE INFRARED SPECTRA OF THE GASEOUS AND SOLID CYANOGEN HALIDES. 2. PREPARATION, PROPERTIES AND STRUCTURE OF HEXAFLUOROAZOMETHANE.

(Publication No. 11,404)

Walter Otto Freitag, Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. E. R. Nixon

The infrared absorption spectra of cyanogen chloride and cyanogen bromide gas at room temperature and of solid films of cyanogen chloride, bromide and iodide at liquid air temperature have been obtained with a double pass prism instrument in the frequency range 3200 to 320 cm^{-1}.

The gas data for ClCN and BrCN are fitted to the general formula for the vibrational energy levels of a linear, triatomic molecule and values for several of the anharmonicity constants are calculated. The Fermi-type resonance between the X-C stretching vibration (ν_1) and the first overtone of the bending mode ($2\nu_2$) is discussed in detail. General considerations are discussed relating the observed separation and intensity ratio of a pair of resonant levels and the unperturbed separation and intensity ratio with the relative signs of the corresponding dipole moment integrals of the two transitions. An expression for calculating the unperturbed intensity ratio is derived. It is concluded that for ClCN and perhaps for BrCN as well, the dipole moment integrals for the ν_1 and $2\nu_2$ modes must have opposite signs.

In the spectra of the solids, bands corresponding to isotopis species containing C^{13} and N^{15} in all three compounds are identified. The spectrum of solid ClCN is related to the known crystal structure and the possibility of moderate bonding between the N and Cl atoms of adjoining molecules in the ClCN chain structure is discussed. An expression for the Hook's law force constant of such a bond is derived. A temperature dependence of the ICN spectrum was observed and may indicate a phase transition for this compound.

Attempts at the preparation of FCN were unsuccessful. Reaction of ClCN with AgF_2 at 80°C. resulted in a mixture of products one of which was isolated and shown to be hexafluoroazomethane, CF_3-N=N-CF_3. The infrared spectrum of this compound from 3200 to 450 cm^{-1} is recorded for both the gas at room temperature and the solid at liquid air temperature. From vapor pressure measurements on CF_3-N=N-CF_3 a Trouton's constant of 18 e.u. and a latent heat of vaporization of 4540 cal. are calculated. Although the infrared spectrum does not definitely establish whether a cis or a trans structure obtains for this

molecule, the total evidence seems to favor the trans form. A detailed assignment of the observed infrared frequencies is given on the basis of the trans form.

An appendix presents detailed instructions for a method of polishing potassium bromide windows for use in infrared instruments and cells.

119 pages. $1.49. MicA 55-958

REACTIONS OF THE HIGH VOLTAGE DISCHARGE PRODUCTS OF WATER VAPOR

(Publication No. 11,405)

Patrick Joseph Friel, Ph.D.
University of Pennsylvania, 1955

Supervisor: Professor Knut A. Krieger

(A) Reactions of the High Voltage Discharge Products of Water Vapor at Low Temperatures.

Hydrogen atoms and hydroxyl radicals produced by the high voltage discharge of water vapor at low pressures were condensed in a liquid air trap. The products were H_2O_2, H_2O, H_2 and O_2. The molar ratios of product to water vapor admitted to the system (r) were 26.8%, 38.0%, 35.2% and 4.2%, respectively.

In order to account for these results two assumptions were made. The first assumption is that the H atoms and OH radicals recombine in a perfectly random manner in the liquid air trap. This assumption predicted that the result should be, H_2O_2 r = 25.0%, H_2O r = 50.0%, H_2 r = 25.0%, and O_2 r = 0%. The reasonable agreement of the H_2O_2 yield with the predicted value indicates that the reaction between two OH radicals has reached a maximum so that no further reaction between two OH radicals can be postulated. Therefore, the reaction leading to the formation of H_2 and O_2 must be: $H + OH = H_2 + O$, occurring on the walls of the trap with the subsequent combination of oxygen atoms to form oxygen molecules. A reasonably constant fraction of the OH radical underwent this reaction. To account for this the assumption was made that the relative probability of the reaction leading to water with respect to the reaction leading to hydrogen and oxygen is determined by the ratio of the squares of the collision diameters of the colliding hydrogen atoms with the oxygen atom in the OH radical and with the H atom in the OH radical, respectively. Calculation of the distribution of products from these assumptions show that the results should be: H_2O_2 r = 25.0%, H_2O r = 33.3%, H_2 r = 41.7%, O_2 r = 8.3%. Although these values show only fair agreement with the experimental results, there is reason to believe that more refined calculations would improve the agreement.

(B) Reaction of the High Voltage Discharge Products of Water Vapor on Silica Gel.

The reaction of H atoms and OH radicals on the surface of silica gel was accompanied by a temperature increase and a green luminescence on the surface of the gel. It was found that the principal products of the reaction were H_2 and O_2 and that both the H atom and OH radical were removed as a result of the surface reaction. The silica gel surface did not catalyze the recombination of H atoms. From this fact, it was concluded that the first step in the reaction of H and OH radicals on silica gel is the preferential adsorption of the OH radical. This is followed by a reaction of some species from the gas phase to form the observed products. Of the two reactions possible, $H + OH = H_2 + 1/2\ O_2$ or $OH + OH = H_2 + O_2$, the first reaction has a lower activation energy. On this basis, it is postulated that the surface reaction is:

$$S\text{-}OH + H = S\text{-}O + H_2$$
$$2\ S\text{-}O = 2S + O_2$$

where S is the surface.

A study of the intensity of the luminescence on the surface of the gel as a function of time and the temperature to which the gel was preheated showed that the activity of the gel was initially high and then decreased to an equilibrium value after thirty minutes. The initial intensity of the luminescence increased as the preheating temperature increased, however, at all three preheating temperatures the intensity decreased with time to the same equilibrium value. These experiments indicated that the water content of the gel controlled its activity in these recombination reactions and that the adsorption of water on the gel during a run was initially rapid and then approached an equilibrium value.

The addition of sodium ions to the gel resulted in a change in the color of the luminescence from green to yellow indicating that the luminescence is a result of an excitation of the surface caused by the highly exothermic reactions occurring thereon.

87 pages. $1.09. MicA 55-959

PROTON TRANSFER, ELECTRICAL RESISTIVITY, AND MAGNETIC SUSCEPTIBILITY IN THE TANTALUM-HYDROGEN AND TITANIUM-HYDROGEN SYSTEMS

(Publication No. 11,293)

William Bruno Hillig, Ph.D.
University of Michigan, 1954

To supplement previous work on the Pd-H system, electrical transport of hydrogen in Ta and Ti was investigated, as well as other properties of Ta-H and Ti-H systems indicative of the electronic structure of the hydrogen component.

In Ta-H the dependence of resistance on composition between Ta and $TaH_{0.28}$ has a positive slope at 76°, 99°, and 400°. In Ti-H at 99° the resistance increases to a maximum, 21% larger than that of the metal, at the composition $TiH_{0.6}$. At 400°, the resistance increases up to 13.4%, this maximum

extending from $TiH_{0.08}$ to $TiH_{0.16}$, and then decreases to the metal value at about $TiH_{0.55}$, and to 88% of this value at $TiH_{1.46}$. The temperature coefficient of resistivity for Ti-H decreases with increasing hydrogen concentration.

Electrical transport was investigated in the Pd-H, Ta-H, and Ti-H systems by measuring resistance changes of two segments of a ribbon upon passage of a direct current. The sign of the change was opposite for the two segments and reversed upon each current reversal. These resistance changes in $TaH_{0.16}$ at 72° and $TaH_{0.209}$ at 99°, as well as in $TiH_{0.048}$ and $TiH_{0.54}$ at 400° show that hydrogen is transported toward the cathode. A preliminary investigation of Pd-H showed the same result, in agreement with Coehn.

The proton mobility, 6 ± 1 (in 10^{-6} cm^2/sec volt), in Ta at 72° is approximately that in Pd; in Ti at 400° it is less than 0.1 of that in Pd at this temperature. Transport numbers for the protons are of the order of 10^{-6} to 10^{-5} for all three systems.

The magnetic susceptibility, 143 (in 10^{-6} cc/formula weight), of Ta metal at 20° decreases with increasing hydrogen content to 106 for $TaH_{0.51}$. That of Ti metal, 148, decreased to a minimum of 144 for $TiH_{0.2}$, and then increased to 179 for $TiH_{1.73}$. The changes of susceptibility and resistivity as functions of composition have opposite signs in both Ta-H and Ti-H, as previously observed for Pd-H.

Allowance was made for non-linearity of the pointer scale of the magnetically damped microbalance used for susceptibility determinations.

X-ray powder studies showed that, upon hydrogen absorption, the a parameter of the b.c.c. Ta lattice increases from 3.300 to 3.333 Å at $TaH_{0.35}$. Only a f.c. orthorhombic phase, $\underline{a}$ = 4.80, $\underline{b}$ = 4.72, $\underline{c}$ = 3.41, was observed at $TaH_{0.51}$ and at $TaH_{0.173}$, the latter having a different thermal history than the other preparations.

The atomic arrangement of the h.c.p. Ti, $\underline{a}$ = 2.944, $\underline{c}$ = 4.697, $\underline{c/a}$ = 1.596, underwent no change up to the composition $TiH_{1.45}$. At $TiH_{1.73}$ only a f.c.c. phase, $\underline{a}$ = 4.463, was found.

The heats of formation, spatial requirements for the H_2 molecule, proportionality of the hydrogen concentration to the square root of the dissociation pressure, magnetic susceptibility, and direction of hydrogen transport show that in Pd, Ta, and Ti the absorbed hydrogen is present neither as H_2 molecules nor, to an extent greater than 16%, as ground state H atoms. The hydrogen is considered to be present predominantly as protons dissolved in an electron system quantized with respect to all positive cores involved. 156 pages. $1.95. MicA 55-960

CALCULATION OF THE HEAT OF SOLUTION AND OTHER EXCESS THERMODYNAMIC PROPERTIES FROM VAPOR-LIQUID EQUILIBRIUM DATA

(Publication No. 11,591)

Donald Earl Hirsch, Ph.D.
University of Pittsburgh, 1955

Essential in precision distillation calculations is the knowledge of the enthalpy-concentration diagram of the mixture of components. The assumption of ideal solutions is often made because the heat of solution is not available. This assumption can lead to serious error for highly nonideal solutions.

A method has been developed of calculating the heat of solution for binary and ternary systems from the vapor liquid equilibrium data. This method is based on a modification of Wohl's three-suffix "q-equations" correlating isothermal x-y-P-T data, and contains no assumptions other than those inherent in the "q-equations" or the method of calculating the activity coefficients.

The heat of solution of the ethanol-water and n-propanol-water system was calculated and compared to published calorimetric values. The calculated n-propanol-water heat of solution curve follows the calorimetric curve closely. The calculated curve for ethanol-water does not fall as closely to the calorimetric values, but the error is less in the range of significance that would be incurred in assuming ideality. The heat of solution was calculated for the ternary system, n-propanol-ethanol-water. The calculated curves show trends that would not be predicted, based on weighted averages of the binary heats of solution. The excess entropy and the excess free energy were calculated for both binary and the ternary systems.

New isothermal vapor liquid equilibrium data are presented for the binary systems, ethanol-water, n-propanol-water, n-propanol-ethanol at 35.0°C, 50.0°C, and 65.0°C. The n-propanol-ethanol data confirm a previously published conclusion that this system is ideal. The new data for ethanol-water and n-propanol water appear to be more probably correct than previously published data in the same temperature range. New isothermal vapor-liquid equilibrium data are presented for the ternary system, n-propanol-ethanol-water at 35.0°C, 50.0°C, and 65.0°C. No vapor liquid-equilibrium data for this system were found in the literature surveyed.

The vapor-liquid equilibrium data were collected with a modified Othmer type still. The equipment and method of operation are described in detail.

150 pages. $1.88. MicA 55-961

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

LOW TEMPERATURE HEAT CAPACITY AND RELATED PROPERTIES OF POTASSIUM AND Na_2K

(Publication No. 11,595)

Carol Alnoth Krier, Ph.D.
University of Pittsburgh, 1955

This low temperature calorimetric investigation was conducted as a phase of a broad research program which is designed to accumulate a body of data to serve as a basis for studying bonding in metals. The objectives of this phase of the program were: (1) to determine the validity of the Kopp-Neumann rule for additivity of heat capacities for Na_2K, (2) to check on possible departure of Na_2K from the third law of thermodynamics, (3) to detect and analyze possible low temperature transitions in potassium and Na_2K, (4) to compare the heat capacity behavior of Na_2K with that for pure sodium and potassium from about 100 degrees below the melting point to 320°K, and (5) to search for evidence of local order in liquid Na_2K.

Using special techniques for handling these highly reactive materials, 99 per cent potassium was triply distilled for additional purification; and a sodium-potassium alloy containing 33.44 atomic per cent potassium was formulated. Heat capacity measurements were performed over the temperature range 12°K to 320°K on these two materials using an adiabatic calorimeter. The thermal history of the samples was controlled and has been recorded.

Tables of data give specific heat and atomic heat capacity values from individual determinations for potassium and Na_2K, smoothed specific heat and atomic heat capacity of potassium, smoothed atomic heat capacity of Na_2K, and $\triangle C_p$ of formation of Na_2K. Nine diagrams show the calorimeter assembly, calorimeter proper and auxiliary sample container, solid-liquid phase diagram of the sodium-potassium system, precision of the heat capacity data, and the atomic heat capacity data for the sodium-potassium system from 12°K to 1100°K.

The eutectic melting point for the sodium-potassium system was determined as -12.65°C, and the incongruent melting point of Na_2K as 6.90°C. No low temperature "transition anomalies" of the type reported for sodium and rubidium were detected for either the potassium or the Na_2K alloy. The entropy of potassium at 298.16°K was determined as 15.38 $\pm$ 0.03 e.u./g. atom; for the alloy the relative entropy at 273.16°K and 320°K is 12.41 $\pm$ 0.08 and 16.55 $\pm$ 0.12 e.u./g. atom, respectively. The alloy deviates negatively from the Kopp-Neumann rule from 15°K to 210°K, and in a positive manner thereafter. The zero point entropy of Na_2K was calculated from ideal solution theory to be 0.18 e.u./g. atom; this value must be viewed with caution for several reasons which are discussed.

Anomalous rising of the heat capacity of the alloy about 100 degrees below the incongruent melting point, as found for the pure metals, indicates that the cause of the anomaly does not lie in the inefficient packing of the body-centered cubic lattice. Heat capacity data for the liquid alloy can be interpreted as indicative of the existence of some local order in the liquid not too far above the incongruent melting point. The literature is reviewed on both of these subjects for the alkali metals.

126 pages. $1.58. MicA 55-962

SCATTERING OF HYDRIDE IONS IN OXYGEN GAS

(Publication No. 11,478)

John Murray McGuire, Ph.D.
The University of Florida, 1955

Investigations have been made of the scattering cross-sections of hydride ions in gaseous molecular oxygen in the energy range of three volts to one-hundred-and-sixty volts incident ion energy. The cross-sections for both the elastic and inelastic types of collision were investigated and the results point to the following conclusions.

In light of the elastic scattering results, it seems quite reasonable to assume that in the low energy region there is a tendency for formation of the O_2H^- ion. The potential expression which best fits the data is

$$(7.1)\quad V = -\frac{8.7 \times 10^{-217}}{r^{28}}$$

over the range of interaction 2.06 - 2.26 Å. It is possible that this type of behavior is a general one for negative ion collisions in which valence or exchange forces are involved. Above twenty volts, the interpretation is complicated due to a rise in cross-section which is attributed to excitation of the molecular oxygen at the expense of kinetic energy from the ionic beam.

The inelastic cross-section goes through a much sharper minimum in the same region as the elastic scattering minimum. The lower energy cross-sections are attributed to charge exchange between the ion and the molecule while the higher energy cross-sections are primarily the result of simple detachment of the electron from the ion to form a hydrogen atom. 57 pages. $1.00. MicA 55-963

ANODE SURFACE EFFECTS IN CONDUCTION THROUGH A VACUUM

(Publication No. 11,566)

Ulrich Merten, Ph.D.
Washington University, 1955

Chairman: Professor Joseph W. Kennedy

Experiments on electrical conduction through a vacuum at potential differences up to 400 kilovolts have been performed. The systems employed each had a small anode fully enclosed in a larger cathode. The currents studied ranged from 1 to 100

micromicroamperes. The general method of investigation is described in the following paragraph.

A source of beta radiation was enclosed in an aluminum housing (the anode) and supported on a fused quartz insulator in a sealed chamber. After the chamber was evacuated, the anode potential rose until the leakage current between anode and cathode counterbalanced the current of beta particles leaving the anode. The dependence of the equilibrium voltage on the experimental conditions measured the effect of these conditions upon the leakage current.

The current was found to consist of an exchange of charged particles between the electrodes, the positive particles making secondary negative particles at the cathode and these negative particles making secondary positive particles at the anode. The anode field and the potential difference between the electrodes affected the voltage at which this current became important, but the cathode field had little or no influence in the range studied (up to 10 kilovolts per centimeter). Contamination of the anode surface was found to be very detrimental to the attainment of high voltage. Greases directly applied had this effect, and various substances with vapor pressures in the 10^{-3} to 10^{-6} millimeter range when placed in the vacuum system were adsorbed on the anode surface and caused the dark current to set in at a low voltage. The potential difference attainable in a given system in the presence of a contaminant condensed on the anode was found to be related to the vapor pressure of the contaminant, the material with the highest vapor pressure generally causing limitation to the lowest voltage.

The experiments suggest that the anodic particles in the exchange dark current are positively charged molecular ions produced within a thin film on the anode surface. The mechanism proposed for their formation is the ionization of the anode film by negative particles from the cathode and the subsequent evaporation of these ions.

The highest potential attained in these experiments was about 400 kilovolts. This was obtained with a Sr^{90}-Y^{90} beta source which gave an initial charging current of 22 micromicroamperes, mounted in a 1-centimeter diameter aluminum sphere and supported on a fused quartz rod in an evacuated spherical vessel, 13 centimeters in diameter. Cleaner conditions and grid control of the leakage currents seem to offer the best routes to further improvements in vacuum insulation. 103 pages. $1.29. MicA 55-964

THE PREPARATION AND PROPERTIES OF CYANIDE AND THIOCYANATE DERIVATIVES OF FLUOROCARBON CARBOXYLIC ACIDS

(Publication No. 11,481)

Robert Hoover Patton, Ph.D.
The University of Florida, 1955

In this study is presented the preparation and some of the chemical and physical properties of twenty-four previously unreported fluorocarbon compounds. These compounds represent eight distinct molecular species. They can be summarized in their respective categories as follows:

1. A series of fluorocarbon carboxylic acid cyanide dimers were prepared by the reaction of a fluorocarbon acid chloride and silver cyanide. Evidence is presented in support of the following structure: $RCOOC(CN)_2R$. The specific compounds prepared were for R equals: CF_3-, CF_3CF_2-, $CF_3CF_2CF_2$-, and $CF_3(CF_2)_4$-. On the basis of molecular weight, calculated from vapor density measurements at constant temperature and variable pressures, it was determined that the vapor of the dimer is not in equilibrium with a significant concentration of a monomer. Also, the monomer was not detected in a variety of reactions from which it might be expected.

2. A series of alpha-hydroxyalkforylmalonamides were prepared by the hydrolysis of the above acid cyanide dimers with concentrated hydrochloric acid. These compounds appear to have the following structure: $RC(OH)(CONH_2)_2$. The specific compounds prepared were for R equals: CF_3-, CF_3CF_2-, CF_3CF_2-CF_2-, and $CF_3(CF_2)_4$-. It was found that these compounds undergo a typical malonic acid decarboxylation when subjected to alkaline hydrolysis, followed by acidification.

3. A series of sodium salts of the alpha-hydroxyalkforylmalonamides were prepared. The specific compounds had alkforyl radicals of CF_3-, CF_3CF_2-, and $CF_3CF_2CF_2$-. Evidence is presented in favor of the sodium ion being associated with the oxygen of the hydroxy group rather than the amide group.

4. A series of mercury derivatives of the alpha-hydroxyalkforylmalonamides were prepared. The specific compounds had alkforyl radicals of CF_3-, CF_3CF_2-, and $CF_3CF_2CF_2$-. It was determined that the ratio of hydroxyalkforylmalonamide molecules to mercury was two to one. Evidence is presented in favor of the mercury being associated with the amide group rather than the oxygen of the hydroxy group.

5. A series of mercury derivatives of fluorocarbon amides were prepared by the reaction of the amide with red mercuric oxide. The specific compounds had alkforyl radicals of CF_3-, CF_3CF_2-, and $CF_3CF_2CF_2$-. The analytical data indicate that there are two molecules of the amide to each atom of mercury.

6. A series of sodium salts of the mercury derivatives of the alpha-hydroxyalkforylmalonamides were prepared. The specific compounds were for alkforyl radicals of CF_3-, CF_3CF_2-, and $CF_3CF_2CF_2$-. The analytical data indicate that the empirical formula of this salt is represented by two alkforylmalonamide molecules, two atoms of sodium, and one atom of mercury.

7. Glutarforyl chloride was prepared and identified by analysis.

8. A series of fluorocarbon carboxylic acid thiocyanates were prepared by the reaction of a fluorocarbon carboxylic acid chloride and silver thiocyanate. These compounds can be represented by the following structural formula: RCO(SCN). The specific compounds prepared were for R equals: CF_3-,

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CF_3CF_2-, and $CF_3CF_2CF_2$-. Because of the striking similarity between the infrared spectra of these compounds and the organic compounds obtained by an analogous reaction, it was concluded that the structures are quite similar. However, experimental evidence is inconclusive to distinguish between a true thiocyanate of isothiocyanate structure.

60 pages. $1.00. MicA 55-965

LOW TEMPERATURE THERMODYNAMIC STUDIES ON PENTAERYTHRITOL AND ITS HALIDE DERIVATIVES

(Publication No. 11,336)

Donald Hughel Payne, Ph.D.
University of Michigan, 1954

The fundamental purpose of the problem was the study of the low temperature thermodynamic properties of the halogen derivatives of pentaerythritol in an attempt to relate the properties of these halides with the transitions occurring in the solid state in neopentane and pentaerythritol.

The studies were carried out by measurement of the low temperature heat capacity of each of the compounds in a low temperature adiabatic calorimeter, and calculation of the enthalpy, entropy, and free energy for each compound as a function of temperature to 298.16°K.

The experimental results show no additional transition in the solid state for pentaerythritol, but a new solid-solid transition in pentaerythritol tetrafluoride with a transition entropy intermediate between that for pentaerythritol and that for neopentane.

It is concluded as a direct result of the research work carried out that the solid-solid transitions occurring in neopentane, pentaerythritol tetrafluoride, and pentaerythritol may best be explained by the order-disorder mechanism for such transitions. Calculated and experimental values for the transition entropies in these compounds are within 0.05 e.u. A principle of additive disorder entropy terms is suggested as a result of the three transitions compared.

131 pages. $1.64. MicA 55-966

RELATIVE ISOTOPE EFFECTS OF CARBON-13 AND CARBON-14

(Publication No. 11,527)

Albert Louis Promislow, Ph.D.
University of Illinois, 1955

The theoretical value for the ratio of C^{14} to C^{13} isotope effects in the thermal decarboxylation of malonic acid is near 1.91; the published values for the C^{14} and C^{13} intramolecular isotope effects (all C^{14} results were obtained from radioactivity measurements) can be combined in various ways to yield isotope effect ratios ranging from nearly 2.0 to as high as 3.6. In an attempt to resolve this apparent discrepancy between theory and experiment, the C^{14} and C^{13} intramolecular isotope effects have been redetermined, employing only mass spectrometric measurements.

The labeled malonic acid was synthesized via the cyanide-cyanoaceteate route. The crude malonic acid was purified on a silicic acid column, using the n-butanol-chloroform solvent system; after preliminary concentration, the product was freed of solvents by sublimation in vacuo at 95-100°. This material was diluted to the desired isotopic composition (about 1% C^{14}, total carbon basis) with Eastman Kodak Co. White Label malonic acid which had been subjected to the same manipulations. The mixture was recrystallized from acetone-benzene, resublimed, then stored at room temperature in a vacuum desiccator.

Carbon dioxide and acetic acid products from the batch decomposition at 140° were purified carefully and the latter was either combusted or degraded to methylamine and carbon dioxide via the Schmidt reaction. All carbon samples, converted to carbon dioxide for mass spectrometric measurement, were equilibrated first with standard water to eliminate the effect of variation in the O^{18} content.

With the calculations based on the carbon isotope ratios of carbon dioxide evolved, acetic acid combustion, and methylamine from acetic acid degradation, the C^{13} and C^{14} isotope effects are found to be 2.87±0.15% and 5.40±0.27%, respectively; the ratio of the isotope effects C^{14}/C^{13} is 1.89±0.19.

While the theory is seen to lead to the correct ratio of the isotope effects, the results indicate values of the order of 40% larger for the individual effects than the predications of Bigeleisen.

The theory of dynamic isotope effects was reviewed critically. It was concluded that though the basic concepts were sound, there has been insufficient sophistication in their application to particular reaction situations. Critical tests of important apparent uncertainties of the theoretical treatment are suggested.

122 pages. $1.53. MicA 55-967

THE POLAROGRAPHIC REDUCTION OF SOME ACETYLENIC LINKAGES

(Publication No. 11,482)

James Cain Ramsey, Jr., Ph.D.
The University of Florida, 1951

Two series of unsaturated quaternaries were formed, each compound containing an acetylenic linkage. In one series, the unsaturated group was held constant, and the saturated groups varied. In the other series, the saturated groups were held constant and the unsaturated group lengthened. It was found that increasing the sizes of the saturated groups lowered the reduction potential of the unsaturated linkage, as measured by the polarograph, while lengthening the unsaturated group strengthened the

triple bond. These results are in agreement with the theory of the effect of resonance on bond strength.

Analysis of the polarograms showed a multimolecular reaction, the number of molecules involved increasing with decreasing strength of the unsaturated bond. The compounds were surface-active to a high degree, approaching detergents in their effect.

A much shorter drop time than conventional was used. Nevertheless, the diffusion current was proportional to the concentration of the reducible substance in the range of 10^{-2} to 10^{-3} N.

38 pages. $1.00. MicA 55-968

SEDIMENTATION AND DIFFUSION STUDIES ON DEXTRAN

(Publication No. 11,534)

John Joseph Scholz, Jr., Ph.D.
University of Illinois, 1955

Measurements of the sedimentation constant, s, and diffusion coefficient, D, of molecules in solution allow calculation of their molecular weight, M, according to Svedberg's equation

$$M = \frac{R\,T\,s}{C\,(1 - \bar{V}\,d)} \qquad (1)$$

where $\bar{V}$ is the partial specific volume of the solute, d the density of the solution, R the gas constant, and T the absolute temperature.

When the solute is inhomogeneous, the sedimentation process tends to separate the species having different sedimentation constants. Therefore, sedimentation velocity experiments, when combined with information about the dependence of molecular weight on s, are a source of information about the distribution of molecular weights in a mixture. However, sedimentation constant distribution analyses are complicated by diffusion during sedimentation which may lead to broader apparent distributions than are actually the case.

This work was undertaken to investigate the application of the sedimentation velocity, diffusion method to the study of molecular weights and heterogeneity of polymers and to apply the technique to the polymer, dextran.

The diffusion process during sedimentation and the assumptions used in previous size distribution analyses were examined. It was shown that earlier treatments which neglected diffusion were not applicable to dextran and that, at least in some cases, current procedures taking diffusion into account could lead only to approximate distributions. An alternative procedure, in which three parameters of an arbitrary distribution function could be determined from the experimental concentration gradient curves and corrections based on a simplified description of the diffusion process, was suggested.

One hundred grams of a total acid hydrolyzate of bacterial dextran (B512 Leuconostoc mesenteroides) of commercial origin as a 1% water solution were divided into 38 fractions by precipitation with anhydrous methanol. Sedimentation constants were determined on all the fractions in a 0.9% sodium chloride solution at several dextran concentrations in the range of 0.7% to 0.07%. Diffusion coefficients were determined on many of the same solutions. The sedimentation constants were found to depend on concentration, so were extrapolated to infinite dilution. No systematic concentration dependence was observed for the diffusion coefficients.

A relationship was found between the sedimentation constant at infinite dilution and the average diffusion coefficient which led to the following relationship between molecular weight and the extrapolated sedimentation constant:

$$M = \frac{R\,T \times 10^{6}\,(S \times 10^{13})^{1.92}}{(1 - \bar{V}\,d)\;12.79} \qquad (2)$$

The distributions of sedimentation constants for a group of typical fractions were estimated by extrapolating the experimental sedimentation gradient curves to infinite time. This procedure, suggested by Baldwin and Williams, makes use of the fact that the broadening of the gradient curves due to inhomogeneity overshadows that due to diffusion as time of sedimentation increases. The general features of the sedimentation constant distributions were found to be very similar, all of them having a width of about 2 s units.

This showed that most of the fractions overlapped, but it was found that they could be arranged into groups with substantially the same distributions as the fractions. These groups could then be summed, taking into account their overlapping, to obtain a sedimentation constant distribution for the total hydrolyzate. The summation consisted of plotting amount of material having sedimentation constants equal to or less than s against s. This is a modification of the cumulative percent method of Schultz.

The resulting curve could then be transformed into a molecular weight distribution function by using equation (2).

130 pages. $1.63. MicA 55-969

THEORETICAL INVESTIGATIONS OF STRUCTURAL CHANGES AND RELAXATION PHENOMENA IN HIGH POLYMERS

(Publication No. 11,024)

Kenneth Walter Scott, Ph.D.
Princeton University, 1949

The mechanical properties of polymeric materials depend markedly on the temperature. At a fixed temperature time effects, such as stress relaxation and creep, play an important role in the mechanical behaviour of these materials. It has been widely accepted that the difference in properties at different temperatures can be simply explained by a change in the internal relaxation times with temperature for the polymeric substances. Experimental evidence is presented which shows that this point of view can be

straightforwardly applied in some cases but leads to difficulties in others. In this paper an attempt is made to clarify the concepts regarding time effects and regarding diffuse structural changes in the interpretation of the properties of the polymeric materials at different temperatures. A one dimensional model for the elastic properties of polymers is presented which incorporates energy and entropy effects.

Most of the previous attempts to describe the process of stress relaxation in polymeric materials used phenomenological approaches. This procedure is unsatisfying since it is difficult to correlate the molecular processes involved in stress relaxation with the mechanical processes of the phenomenological model. A molecular theory of stress relaxation in polymeric media is developed. The stress relaxation in this molecular model is governed by the making and breaking of crosslinks between polymer chains. For this model the stress decays nearly exponentially. 71 pages. $1.00. MicA 55-970

A STUDY OF PROTEIN DENATURATION BY MEANS OF THE OPTICAL ROTATORY POWER

(Publication No. 11,027)

Richard Barton Simpson, Ph.D.
Princeton University, 1949

The denaturation of egg albumin and of serum albumin by urea and other chemical reagents was studied by means of the change in optical rotation.

Part 1. Egg albumin. The optical rotation of egg albumin in urea solutions increases considerably with time. The change may be divided into two stages, a "primary" reaction, with which we are mainly concerned, and a very slow "secondary" reaction.

The kinetics of the primary reaction do not obey a simple first order law with respect to the protein concentration. This indicates either that egg albumin consists of several components each denaturing with a different first order rate constant, or that the denaturation process is made up of a sequence of reactions which are of the first order in the protein concentration. Comparison of the kinetics of denaturation under various conditions shows that each of these partial reactions must be affected to nearly the same extent by changing the temperature and the composition of the reaction mixture. This is not true of the effects of detergents, iodine, or of some organic substance, however. Under most conditions, therefore, the primary reaction may be characterized by the specific rotation $[\alpha_f]$ attained at the end of the primary reaction, and by the half time of the reaction -- that is, the time required for the rotation to change from the value for the native protein half-way to $[\alpha_f]$.

Under a standard set of conditions, the half time and final specific rotation for the denaturation of samples from different stock solutions may vary considerably. The reason for this is not understood.

The half time is found to be inversely proportional to the fifteenth power of the urea activity at 0°C., and to a smaller power of the urea activity at higher temperatures. This exponent is interpreted as the number of molecules of urea that must combine with egg albumin in order to denature it. The value of $[\alpha_f]$ increases with increasing urea concentration or with decreasing temperature.

At a given urea concentration the rate of denaturation has a negative temperature coefficient between 0°C. and 20°C., and a positive temperature coefficient above 20°C.

Decreasing the protein concentration results in a slight increase in both $[\alpha_f]$ and the half time.

The rate of denaturation in 7.3 M urea is a minimum near pH 8, but does not change greatly over the range from pH 6 to 9.

Highly charged positive ions apparently accelerate the urea denaturation, while highly charged negative ions inhibit it. In addition, various ions have specific effects on the rate, however, sulfate and phosphate being potent inhibitors, while iodide and thiocyanate accelerate the reaction strongly.

Ions generally tend to decrease $[\alpha_f]$.

In a series of organic compounds containing hydroxyl groups it was found that the effect on the rate depends on the ratio of the number of hydroxyl groups to C-H bonds; compounds for which this ratio is large (sucrose, glycerol) inhibit the reaction, while compounds for which it is small (ethanol) accelerate the reaction.

Iodine at very low concentrations decreases the half time considerably.

The effects of guanidine salts and of sodium dodecyl sulfate were investigated in both the presence and absence of urea. Guanidine hydrochloride has nearly the same effect as urea on the half time and on $[\alpha_f]$, but only one-third the concentration is necessary to produce a given effect. Even at very low concentrations, sodium dodecyl sulfate (SDS) causes an immediate increase in the optical rotation followed by a further slow increase. In the presence of urea, SDS decreases both the half time and $[\alpha_f]$.

In 7.3 M urea solution egg albumin forms gels if the protein concentration is above about 2%. Some of the factors influencing this gel formation are mentioned.

A study has been made of the behavior of the optical rotation when the urea concentration and the temperature are changed during the reaction, with a view to learning something of the reversibility of urea denaturation. The results indicate that a complex sequence of reactions must be involved.

Part 2. Serum albumin. The optical rotation of serum albumin also increases markedly in the presence of urea, but this increase is practically instantaneous at all urea concentrations for temperatures below 40°C. The specific rotation below 40°C. depends on the urea concentration and on the temperature in much the same way as does the final specific rotation of egg albumin in urea. It depends only slightly on pH.

On heating to temperatures above 40°C. the rotation increases and this increase persists on cooling. The time dependence of the increase on heating is complex.

The change in rotation on addition of urea is reversible on dilution and on changing the temperature

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if high temperatures and long times of exposure are avoided.

Sodium dodecyl sulfate in very low concentrations prevents the increase in optical rotation caused by urea, but this is not the case at high concentrations of this detergent. 164 pages. $2.05. MicA 55-971

KINETICS OF THE THERMAL NON-CATALYTIC REACTION OF AMMONIA WITH OXYGEN

(Publication No. 11,034)

Edgar Ray Stephens, Ph.D.
Princeton University, 1951

This dissertation is concerned with the gas-phase, non-catalytic oxidation of ammonia with molecular oxygen. An experimental study of the products of this reaction and its kinetics was made using both the flow and static methods. In addition the influence of surface on the reaction was investigated in the flow system using reaction vessels of four types: 1) an empty quartz tube, 2) this same tube coated with potassium chloride, 3) a quartz tube packed with pieces of quartz tubing to increase the surface to volume ratio, and 4) this packed tube after coating with potassium chloride.

Although there is very little literature which is closely related to this study a short review of work which has been done with ammonia is given under four headings: 1) the ignition limits of ammonia-air and ammonia-oxygen mixtures, 2) the spectroscopy of the ammonia-oxygen flame, 3) the photochemistry of ammonia, and 4) the reaction in the presence of a catalyst. About thirty references are cited.

In both the flow and static work the evidence indicates that nitrogen and water, formed by the overall reaction:

$$4NH_3 + 3O_2 = 2N_2 + 6H_2O$$

are the principal products but that there is a third product, probably nitric oxide, formed in smaller amounts. Evidence for this includes chemical tests made on the products of the reaction in the flow system and some gas analyses which were carried out on the products of the reaction in the static system.

The kinetics of this reaction presented several interesting features. First to be observed in the flow system was the fact that the percentage of the input ammonia which reacted per unit time increased continuously while decreasing the ammonia concentration from 75% to 1%. The results of some calculations which show that for lean mixtures (where the effect of ammonia is isolated from that of oxygen) the rate is zero order in ammonia are given. For richer mixtures the zero order constant decreases indicating either are inverse dependence of rate on ammonia or a direct dependence on oxygen.

The second feature of this reaction which was discovered is the remarkable influence of surface. Comparison of the rates observed in the four different reaction tubes used in the flow work showed that packing had little effect on the rate of reaction but that coating with potassium chloride caused a marked decrease in rate in both the empty and packed bulbs. Thus surface character is important while amount of surface is unimportant. A qualitative explanation of this in terms of reaction chains which both start and stop on the wall is offered.

In the static system the course of the reaction was studied by following the total pressure as a function of time with various compositions, total pressures, and temperatures. Using the initial slope of the pressure versus time curve as a measure of the rate of reaction, the increase of rate with decreasing concentration of ammonia which was observed in the flow system was apparent here as well. Comparison of the rates of reaction in runs with increasing amounts of one reactant while the other is held constant indicate that the rate is directly dependent on a high power (probably the square) of the oxygen pressure while the ammonia pressure has a complex effect, causing an increase in rate on the rich side and a decrease in rate on the lean side (with increasing ammonia). Products of half and quarter lives with initial total pressure were calculated and shown to be constant for a given mixture with increasing total pressures indicating that the rate is second order in total pressure. The rate equation:

$$-\frac{dP_{O_2}}{dt} = kP_{O_2}^2$$

were tested and found satisfactory for lean mixtures but for rich mixtures it is concluded that the ammonia pressure must appear in the rate equation. Accordingly the integrated form of:

$$-\frac{dP_{NH_3}}{dt} = \frac{kP_{O_2}^2}{1 + k'P_{NH_3}/P_{O_2}}$$

was tested with only moderately successful results.

The activation energy for the reaction was determined from the inital slopes as well as the quarter and half lives for the 2 ammonia- 1 oxygen (temp. = 625-725°C) and the 1 ammonia- 2 oxygen (temp. = 525-625°C) mixtures. Values ranging from 42.2 to 48.0 Kcal. were obtained.

A few experiments in which other gases (nitrogen, water, and nitrogen dioxide) were added showed that only the last of these had any effect on the reaction and it caused a very rapid reaction even at room temperature.

Some speculations on possible chain mechanisms for this reaction in the light of this and other work are given. 102 pages. $1.28. MicA 55-972

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A CONTRIBUTION TO THE CHEMICAL PHYSICS OF SULFUR VULCANIZED NATURAL AND SYNTHETIC ELASTIC POLYMERS

(Publication No. 11,035)

Malvin David Stern, Ph.D.
Princeton University, 1949

The aim of the research reported in this thesis was to apply the techniques of stress relaxation at constant extension and creep to the study of some of the chemical properties of sulfur cured vulcanizates. The stress in an elastic polymer has been related to the number of crosslinks or chains in the network through the development of the kinetic theory of elasticity. Chemical agents, which react with either the sulfur crosslinks or with groups on the network chains with consequent scission of chemical bonds during reaction, cause the decay of stress in an extended or strained network. One phase of this research deals with the attempt to determine the number of sulfur linkages of a given type established during vulcanization. Methyl Iodide is a reagent which has been shown to cause scission of the sulfur-carbon linkage in allylic sulfides. It has recently been shown that allylic sulfides are formed as one of the major products of the reaction of low molecular polyisoprenes with sulfur. Therefore, stress decay and creep were measured in the presence of Methyl Iodide and in the absence of oxygen, at high temperatures. Polysulfides are also formed during the reaction of sulfur with polyisoprenes. In order to learn something of the stress-chemical properties of polysulfide systems, an investigation of the stress relaxation behavior of polysulfide rubbers was undertaken. These rubbers exhibit a simple, exponential type of stress decay very similar to that of hydrocarbon rubbers undergoing oxidative scission, and also show wide variations in rates of stress decay as a function of compounding ingredients, chain structure, and temperature. A chemical mechanism has been proposed in explanation of their stress, time, and temperature behaviour, and this has been supported by the further research of Mochulsky and Tobolsky. Sulfur, mercaptans and mercaptides have been shown to accelerate the rate of stress decay in these polymers, and, therefore, are reagents for the scission of polysulfide linkages. The recent work on mercaptide-disulfide exchange reactions lays emphasis upon the role of mercaptides in the proposed chemical exchange process. Lastly, an investigation of oxidative stress decay in various experimental, natural rubber vulcanizates was undertaken. Previous researches of Tobolsky and coworkers had shown that the natural rubber vulcanizate, Hevea 198, exhibited the simple exponential type of stress decay. In the present study, an attempt is made to learn the effects of the various agents usually included in the compounding formulas of vulcanizates on the stress decay of these stocks. The variables of vulcanization such as accelerators, zinc oxide, curing time, curing temperature, sulfur, etc. were systematically varied, and rate of stress decay was measured over the temperature range 70°C. to 90°C. Activation Energies for stress decay varied widely depending on the compounding ingredients and temperature. A theory of oxidative stress decay is proposed following a broad survey of the literature. The relationships between bond scission, stress decay and the rate of hydroperoxide decomposition are made explicit. Oxygen absorption is related to chain scission in the case of severe inhibition of oxidation. The role of accelerators as initiators of free radical oxidation chains are indicated, and the roles of various inhibitors and inhibiting processes are discussed.

353 pages. $4.41. MicA 55-973

A STUDY OF THE RELATIONSHIP BETWEEN CATALYTIC ACTIVITY AND CRYSTAL SIZE

(Publication No. 11,437)

George Joseph Stockburger, Ph.D.
University of Pennsylvania, 1955

Supervisor: K. A. Krieger

An unsupported zinc oxide catalyst was studied for the effect of crystallite size on the catalytic activity evaluated for the oxidation of carbon monoxide. Catalyst samples with a crystallite size ranging from 100 Å to greater than 500 Å, as estimated from the width of the X-ray diffraction lines, were prepared by the thermal decomposition of zinc carbonate. The empirical rate equation was found to obey the expression $v = k\, p_{CO}\, P_{O_2}^{1/2}$. Below 400 Å a continuous decrease in catalytic activity was observed with decreasing crystallite size. Above 400 Å the catalytic activity appears to reach a maximum with a subsequent decrease at still larger sizes. This phenomena could be explained either by depth action or pore size. In this investigation the latter possibility appears to be more favorable. 87 pages. $1.09. MicA 55-974

AN INVESTIGATION OF THE POSSIBILITY OF THE SEPARATION OF TRIGLYCERIDES BY COUNTERCURRENT DISTRIBUTION

(Publication No. 11,609)

Joseph John Taber, Ph.D.
University of Pittsburgh, 1955

The behavior of individual triglycerides in several two-phase, solvent systems was investigated to predict which of these solvent systems would be most suitable for the separation of these triglycerides by countercurrent distribution. Partition coefficients of the triglycerides were obtained by determining the weight of solute in each phase, and, for some of the systems, from countercurrent distribution reslts. The variation of partition coefficients with temperature in a two-component, solvent system and the variation of partition coefficients with system

composition in a three-component solvent system was investigated.

The types of solvent systems that were found in this investigation to be the most promising for the separation of triglycerides were two-component solvent systems at an optimum temperature near the critical point and three-component solvent systems at an optimum composition near the plait point. It was found that the theory of regular solutions can be applied as an approximation to the systems studied in this investigation. By the use of this theory one can obtain for a pair of solutes in a given two-component or three-component solvent system a constant γ. This constant can be used in several criteria of separation to predict the amount of separation that can be expected under prescribed conditions and to obtain the conditions that will give maximum separation. Values of γ were determined for triolein and tristearin in the systems hexane—nitroethane, hexane—acetonitrile—chloroform, and hexane—chloroacetonitrile—chloroform. Values of γ for trilaurin, trimyristin and tripalmitin were determined in the system hexane—acetonitrile—chloroform.

It was found that in the hexane—nitroethane system there is a wide temperature range for which nearly optimum separation is predicted; for the systems hexane—chloroacetonitrile—chloroform and hexane—acetonitrile—chloroform there is a wide range of the percentage of chloroform for which nearly optimum separation is predicted. It was found that the presence of moisture in the hexane—acetonitrile—chloroform system lowers the separation that is predicted for triolein and tristearin.

176 pages. $2.20. MicA 55-975

FACTORS THAT INFLUENCE THE MAGNITUDE OF THE CONTACT ANGLE

(Publication No. 11,365)

Jeptha Wade Van Valkenburg, Jr., Ph.D.
University of Michigan, 1955

The tendency of a liquid to wet a solid is most generally determined by placing a drop of the liquid on the plane surface of the solid and by measuring the angle formed by the liquid drop on this surface. The magnitude of this angle constitutes a measure of the degree of wetting of the solid by the liquid.

Simple as this method appears to be different investigators often report quite different values for the contact angle obtained with a given system. The differences in results reported undoubtedly arise from the fact that supposedly similar systems actually were not identical or that some of the factors associated with the process of measurement were either different or were not kept under proper control. Accordingly this research was concerned with a consideration of the factors that tend to influence the magnitude of the contact angle formed between a liquid and selected solids. It is believed that the results obtained have served to clarify a number of the apparent discrepancies found in present day literature.

The magnitude of the contact angles formed on the surface of high free surface energy solids such as the noble metals is greatly influenced by adsorption of constituents from the atmosphere. It was found that adsorbed organic vapors are readily removed by heat treatment and that this adsorption-desorption process is reversible.

The magnitude of the contact angles formed on various solids such as minerals is greatly influenced by adsorption of water vapor. Clean surfaces of mica, sphalerite, fluorite, gypsum, and calcite become contaminated upon exposure to air containing water vapor with consequent changes in wetting properties and contact angles.

The magnitude of the contact angles formed on a solid which may exist in more than one crystal form is dependent upon the form which exists or which predominates at the time measurements are made. Amorphous forms of lead sulfide and antimony trisulfide form larger angles of contact with water, and thus are more hydrophobic, than are crystalline forms of these solids.

The magnitude of the contact angle is dependent upon the precise chemical composition of the surface of a given substance. If a chemical reaction, even though small in extent, occurs on a solid surface the alteration in contact angle value will serve as a definite criterion of the change. It was found that lead sulfude reacts chemically with water and carbon dioxide to form a basic carbonate with attendant change in the water contact angle. Antimony trisulfide is easily oxidized. Even at room temperature its surface became so oxidized that contact angles measured upon it were practically identical with those measured on the oxide.

The magnitude of contact angles formed by liquids on soft solids is generally not dependent upon such factors as adsorption, surface structure and reaction between phases. The properties of plastics, however, may be affected by the thermal and pressure treatment of the solid. It was found in this investigation that Teflon, which had been given extended heat treatment, exhibited wetting properties, as determined by contact angle measurements, which were different from those of the untreated samples.

This investigation has shown that when measuring contact angles of a liquid on a solid surface one must always consider such factors as the possible adsorption of gases, the adsorption of water vapor, the exact crystal form of the solid and the purity of the surface of the solid at the time measurements are being made. Also one must consider whether the solid has been subjected to other influences which may in some way have altered its surface tension or free surface energy level. 120 pages. $1.50. MicA 55-976

A RAMAN SPECTROSCOPIC INVESTIGATION OF THE MOLECULAR COMPLEXES PRESENT IN DIMETHYL ETHER-HYDROGEN CHLORIDE AND DIMETHYL ETHER-HYDROGEN BROMIDE SOLUTIONS

(Publication No. 11,366)

Guido Levi Vidale, Ph.D.
University of Michigan, 1955

The purpose of this study is the investigation of the nature and of some of the properties of the hydrogen bond and of oxonium complexes. To this end, a Raman spectroscopic investigation has been carried out of the molecular complexes present in binary solutions of dimethyl ether and hydrogen chloride, or hydrogen bromide. The interest in these particular systems arose from the possibility that they might be described in terms of simple, stable complex species with little tendency to form extensive polymeric structures.

The interpretation of the spectra of the binary solutions required a detailed knowledge of the spectrum of pure dimethyl ether. The initial phase of this investigation, therefore, consisted of a careful study of the Raman spectra of the liquid and gaseous ether.

Raman spectra of a number of solutions containing hydrogen chloride, hydrogen bromide or deuterium chloride in dimethyl ether were obtained at temperatures ranging from 5 to -90° C. A careful analysis of the bands attributed to the skeletal frequencies of the ether molecule reveals the presence of several sharp peaks which cannot be assigned to the component molecules. These spectra can be interpreted satisfactorily, however, in terms of three simple stable complexes, which are arbitrarily designated as complexes A, B and C.

Bands due to complex A are observed in the spectra of the more ether-rich solutions containing HCl or DCl, but not in the HBr solutions. A comparison of spectra obtained from HCl and DCl solutions indicates that this structure is best described as a simple hydrogen bonded structure having the following formula: $(CH_3)_2O{\cdot}HCl$. In this complex the hydrogen atom still "belongs" to the chlorine atom. Complex A probably corresponds to the equimolar complexes that have been reported in the gaseous and the solid phases, and it is quite stable in the liquid state.

The complexes designated as B or C appear to be present in all three systems studied. The comparison of the spectra of these complexes in the three systems indicates that they are ionic or ion pairs, and that they must be classified as oxonium structures in which the proton is strongly bound to the oxygen atom of the ether molecule. In the HCl and DCl systems these complexes are present only in acid-rich solutions at the lower temperatures, and their presence probably depends on the solvation of the anion by molecules of acid. In the HBr system instead these complexes are present under all the conditions studied and are considerably more stable. The great acidity of hydrogen bromide apparently leads to the formation of the ionic complexes even in the absence of the anion. The data obtained are not sufficient to determine unambiguously the composition of the two complexes.

The vibrational bands due to motions of the acid hydrogen atoms are discussed in terms of the modern theories of hydrogen bonding. It is concluded that these observations are in agreement with the explanation presented above.

The findings of this study indicate that the solutions investigated consist of simple solutions of three definite complex species and of the uncomplexed component molecules. It has further been shown that these complexes may be described satisfactorily either as simple hydrogen bonded or as oxonium type structures, implying that the hydrogen bonded protons belong primarily to a single electronegative atom.

139 pages. $1.74. MicA 55-977

ALKALI METAL STUDIES III. THE CONDUCTANCE OF CONCENTRATED SOLUTIONS OF LITHIUM IN METHYLAMINE AT -23° C.

(Publication No. 11,445)

Archie R. Young, II, Ph.D.
University of Pennsylvania, 1955

The conductances of solutions of lithium in methylamine over the concentration range between 0.035 and 5.25 g-atoms per liter of solvent are reported and preliminary investigations of the temperature coefficients of conductance of lithium in methylamine are discussed.

Methods of purifying the solvent and of introducing pure lithium metal into the conductance cells are described. The stability of the solutions during the resistance measurements is discussed, and approximate vapor pressure data are given for solutions of lithium in methylamine.

The derivation of the Farkas Equation for the conductance of alkali metals in liquid ammonia is given, and a modified Farkas Equation os constructed which fits the experimental data for the conductance of sodium in liquid ammona. The conductance of lithium in methylamine is treated by means of the Farkas Theory, and it is found to conform satisfactorily to the original Farkas Equation.

The conductance of lithium in methylamine is compared with the conductance of alkali metals in liquid ammonia. The conductances are approximately 100-fold less in methylamine than in liquid ammonia.

The conductance of lithium in methylamine is compared with the conductances of typical salts in methylamine.

It is concluded that the conduction process in lithium-methylamine solutions is to some extent electronic, however, the electrons are considerably hindered in this solvent.

87 pages. $1.09. MicA 55-978

ECONOMICS, GENERAL

THE ILLINOIS BROILER INDUSTRY

(Publication No. 11,488)

Ralph Albert Benton, Ph. D.
University of Illinois, 1955

The growth and development of the Illinois commercial broiler industry was part of a rapid national expansion due in large part to such economic factors as (1) high consumer demand; (2) broiler-meat prices more favorable than red-meat prices; (3) liberal credit to producers; (4) improved marketing procedures and facilities; (5) lower costs; and (6) lack of alternative opportunities.

In Illinois production has become quite general over the state but with the heaviest concentration in the vicinity of Chicago, Peoria, St. Louis, and in Franklin and Williamson Counties in Southern Illinois. Approximately 700 persons in Illinois grew broilers in 1953. Between 70 and 75 percent of all broilers produced were White Rocks.

A study of 84 Illinois growers and 2,048,731 birds in 300 lots revealed an average investment in fixed capital of $7,635 per grower, or $1.15 per bird housed. The average investment in operating capital was $4,266, or 63 cents per bird. The average cost of producing broilers was 24.8 cents per pound. Feed accounted for 60.7, chicks 22.1, labor 5.4, fixed charges 5.0, and miscellaneous items 6.8 percent of total costs. Net return per bird was 10 cents, or 3.3 cents per pound.

The study showed that production costs per unit were steadily reduced as size of operations was increased until the 10,000 to 12,499 size lot was reached. Beyond this size costs per unit increased. Also, as size of lot increased, labor per 1,000 birds decreased largely because of the use of automatic feeders and waterers.

The evidence indicated a definite relationship between mortality and net returns. Increased mortality was accompanied by higher production costs and lower net returns. Average mortality was 6.4 percent. Approximately 75 percent of all lots suffered losses from disease.

Approximately 60 percent of Illinois growers used short-term credit for feed and chicks. Slightly less than one-half of all growers were financed by feed dealers, mostly by an increased price per ton of feed sold.

Illinois broiler growers have reasonably good markets for their finished birds. However, there is only one processor with capacity large enough to take all the birds from a large house at one time. As a result, nearly two-thirds of the broilers sold received only one bid. This was a source of dissatisfaction among the producers of large lots. Most processors in Illinois are relatively small operators who buy live birds and sell the dressed product within 50 miles of their plants.

The number of birds marketed each month was irregular. This irregularity makes it difficult for a large capacity processing plant to get the birds it needs to keep the plant operating at full capacity. At present Illinois growers are supplying about one-half of all broilers consumed in the state.

Broiler production can be expanded rapidly. A production cycle is completed in 10 weeks on the average. Too rapid expansion has hurt producers by resulting in too many broilers on the market, thus forcing prices below cost of production. Apparently this study was made during the period when the peak of production was being reached. A sharp break in broiler prices late in 1953 marked the entrance of the industry into a stage of negative returns.

The broiler industry is a typical case of a new industry in a competitive situation. In 1954 it reached a production peak. Will it develop a typical cyclical pattern with a period of high output and low prices, alternating with periods of lower output and higher prices? Economic theory suggests that this would likely be the case in an industry which is inherently as competitive as is broiler production. 197 pages. $2.46. MicA 55-979

THE TRI-STATE ZINC-LEAD MINING REGION: GROWTH, PROBLEMS AND PROSPECTS

(Publication No. 11,581)

William James Cassidy, Ph. D.
University of Pittsburgh, 1955

This is a study of the development, problems, and prospects of one of the major zinc-lead mining areas in the United States: the Tri-State District where Missouri, Kansas, and Oklahoma adjoin one another.

The initial focus of analysis is the pattern of development of zinc-lead mining both in the United States and in the Tri-State District – the former providing the framework for interpreting the latter's experience. In tracing the national development of zinc-lead mining, attention is given first to the changing shares of smelter supply furnished by domestic mine production, imports, and scrap. This review leads to the analysis of growth patterns in domestic zinc-lead mining with particular emphasis on long-term trends and short-term fluctuations in output and employment between 1907 and 1950. After

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

examining the effect on these adjustments of price changes, appropriate output and employment data are used to analyze productivity adjustments, allowing due consideration to changes in the metallic content of the ores mined.

The resulting picture of U. S. zinc-lead mining adjustments is then compared with the Tri-State's growth pattern to reveal major similarities and dissimilarities. In seeking to explain the particular pattern of Tri-State adjustments, attention is given to its following unique characteristics:

1. The geological formation of local ore-bearing strata.
2. The curious leasing system which long throttled the pressures for larger-scale operations.
3. The cultural characteristics of the hill-folk from the Ozarks who constituted both work force and management.
4. The nature of the mining and milling practices which developed and the factors which supported their survival value.
5. The pattern of local distribution arrangements.

In turn, evidence of the gradual surmounting of some of these obstacles then provides the basis for assessing the possibilities of modifying and even reversing past trends in the Tri-State's competitive position.

Attention turns next to a review of some of the human and industry costs engendered by the Tri-State's development pattern and the extent to which these burdens have served to reinforce the undermining of the area's competitive position. Among these special burdens have been silicosis and related problems, a high accident rate, and an extraordinary variability in the level of mining operations and of employment. After reviewing the variety of efforts made to deal separately with each of these problems, an analytical framework is provided for considering both the inter-relationship among these problems and their integral connection with the means of revitalizing the area's economic development. A part of this review of ameliorative efforts is devoted to the development of organizations by miners and by operators as well as to other organized efforts to deal with the problems of the area.

The final section of the study centers on the future prospects of the Tri-State area as well as on certain broader implications of the findings. With respect to the first of these, the conclusion is offered that the area has quite favorable prospects, but that the full realization of such potentials will require a sharply accelerated advancement of mining methods together with the development of more effective cooperation among operators and miners in promoting their joint stake in the area's competitive position. In considering the broader implications of the study, attention is given to the need for developing a more systematic public policy for dealing with the problems of industries and areas which are inevitably forced towards the margin of economic survival as a by-product of growth in other industries and other regions.

326 pages. $4.08. MicA 55-980

THE ROLE OF INTERNATIONAL SPECIALIZATION IN THE ECONOMIC DEVELOPMENT OF TURKEY

(Publication No. 11,454)

Shmuel Gottlieb, Ph. D.
Columbia University, 1955

Since the comparative advantage of many underdeveloped countries is in agricultural products, the case for international specialization in these countries depends upon the relative desirability of developing agriculture.

There have been numerous objections to the theory of comparative advantage and to the desirability of emphasizing agricultural development. The purpose of the study is to test the validity of these objections in the framework of an examination of the conditions for agricultural specialization in Turkey.

Formulation of the assumptions is followed by establishment of some key factors which determine the most desirable allocation of resources in a given country. These factors are:

first, the level and structure of internal demand and the effect of a given development program upon them;

second, the relative supply and productivity of factors of production;

third, the changes in the relative supply and productivity of factors through time;

fourth, the level and structure of foreign demand. The position of a country in world markets, and the effect of a given development program on the terms of trade.

As many other underdeveloped countries, Turkey enjoys a comparative advantage in agricultural products. The thirty years of the Republic provide a good comparison between two patterns of allocation of resources. During the first period, mainly in the thirties, economic policy was geared towards intensive and rapid industrialization. During the second period, the emphasis shifted to agriculture. On the whole, the rate of growth in the second period was at least double the rate of the preceding one. In spite of some intervening factors, mainly the economic aid received from the US, the different patterns of allocation of resources must account for a large part of the difference in the rates of growth.

On the demand side, the industrialization program failed in three ways: (1) to stimulate sufficient effective demand; (2) to stimulate further growth through increases in industrial investment; and (3) to diffuse development benefits throughout the economy. None of these factors were operative in the second period.

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Turkey has a scarce supply of capital and an abundant supply of land and labor. As many other underpopulated countries, Turkey suffers from a low level of productivity and a considerable amount of disguised unemployment. A higher rate of growth can be achieved by emphasizing agricultural rather than industrial development. Moreover, due to the high cost of transfer, a large change in the urban-rural population ratio is impossible. An increase in agricultural investments and the absorption of the disguised unemployed in agriculture is, therefore, a preferrable solution.

Except in some light industries, there were no large increases in productivity in the industrial sector during the 1930's. Due to the relatively small size of this sector, its "absorptive capacity" was also limited. Concentrating investments in industry might cause "bottlenecks" in the supply of factors. In contrast, the "absorptive capacity" of agriculture is still very large. During the second period, large increases in agricultural productivity were realized.

The relation between income and the demand for agricultural products makes the availability of an adequate foreign demand a prerequisite to any large agricultural development. No loss of income would be incurred by trade at the given level of the terms of trade. Also, Turkey could not readily affect her terms of trade by increasing exports since, especially in wheat and cotton, she accounts for only a small fraction of world exports. Only a severe long-run deterioration of world market prices of wheat and cotton may decrease the desirability of specialization. There is no a priori reason to believe that such a price movement will occur. 274 pages. $3.43. Mic 55-91

CHANGES IN THE RATIO OF LIQUID ASSET HOLDINGS TO INCOME AMONG GROUPS OF AMERICAN CONSUMERS BETWEEN 1947 AND 1951 AND SOME EFFECTS OF LIQUID ASSET HOLDINGS ON SPENDING

(Publication No. 11,287)

Harold Woodson Guthrie, Ph. D.
University of Michigan, 1955

This research is addressed to two problems, viz., (1) to discover descriptive characteristics which will define groups of consumers who differ significantly from each other with respect to changes in liquid asset holdings between 1947 and 1951; (2) to discover the relationship between liquid asset holdings and spending for durable goods among consumers in certain years. Since a given absolute amount of liquid assets held by several consumers whose incomes are markedly different cannot be considered to influence the behavior of each consumer in the same way, the principal variable in this research is the ratio of liquid assets to income.

The principal data were derived from three Surveys of Consumer Finances conducted for the Federal Reserve Board by the Survey Research Center, University of Michigan, in the early months of the years 1948, 1952, and 1953. The three studies did not include identical consumer units. Thus, the method used in this research is that of comparing groups of consumers rather than individual consumers.

With respect to the first problem it is concluded that the ratios of liquid assets to income decreased relatively:

(a) more among high income people than among low income people,

(b) more among young people than among older people,

(c) more among consumer units containing two or more persons than among consumer units containing only one person, and

(d) more among consumer units living in the South than among those living in other areas of the United States.

These conclusions are developed from analyses of variance in which the dependent variable is measured by weighted means of ratios of liquid assets to income for cells of unequal size.

For the second problem, determining the relationship between the ratio of liquid assets to income and consumer spending, the dependent variable is the ratio of durable goods expenditures to income. Regression equations for the years 1948, 1949, 1951-1952, and 1952 are used to evaluate the net effect of the following alternative hypotheses:

A. Durable goods expenditure ratios will tend to be positively related to liquid asset ratios because liquid assets provide the money used in the purchase of durable goods.

B. Durable goods expenditure ratios will tend to be positively related to liquid asset ratios because people can be "satiated" with liquid assets.

C. Durable goods expenditure ratios will tend to be negatively related to liquid asset ratios because people who have high liquid asset ratios are habitual savers, and they will continue to save in liquid form.

On the basis of the regression analyses none of the three hypotheses can be associated with a gross effect which is strong enough over time to dominate consumers' spending behavior.

The research is designed to test the hypothesis that durable goods expenditure ratios tend to be positively related to relative change in the ratio of liquid assets to income. Although no evidence is found to support this hypothesis, the data suggest that there may be a positive relationship among larger consumer units between durable goods expenditure ratios and the combined effect of increases in the liquid asset ratio and relatively high levels of the liquid asset ratio.
176 pages. $2.20. MicA 55-981

CODETERMINATION IN WEST GERMANY

(Publication No. 11,433)

Abraham Shuchman, Ph. D.
University of Pennsylvania, 1955

Supervisor: Paul F. Gemmill

This dissertation seeks to clarify and describe 1) the meaning of codetermination; 2) the origins and development of the demand for codetermination; 3) existing codetermination legislation; and 4) some of the economic implications of codetermination. It defines codetermination as that form of economic democracy in which workers or their representatives "co-decide" social, personnel, and economic policy matters within plant and enterprise as well as welfare, manpower, and economic policy matters under the jurisdiction of quasi-governmental agencies. In addition, parliamentary bodies consult with workers or their representatives before welfare, manpower, or economic policy decisions are made and executed.

In describing the origins and development of codetermination, stress is placed on the mixed intellectual parentage of the idea, on the expansion of the kinds of decisions subject to codetermination, and on the emergence of an institutional structure through which codetermination may be practiced. It is shown that during the past century worker participation in decision-making for the enterprise and/or the economy has been advocated by socialists, corporatists, and liberals, and that its practice has been extended from social and welfare decisions to personnel and manpower decisions, and then to economic decisions. Also, emphasis is placed on the evolution of a set of institutions, consisting of the trade unions, works councils, industry councils, and economic councils, through which codetermination may be implemented.

In discussing existing codetermination legislation, the social, political, and economic forces which produced these laws are described. An analysis is made of the "Codetermination Law of 1951 (Mitbestimmungsgesetz)," its scope, the reconstruction of the supervisory and management boards of steel and coal enterprises for which it provides, and the experience under the law to this time. And in analyzing the "Plant Organization Law (Betriebsverfassungsgesetz)," the organization and functions of individual works councils, joint works councils, economic committees, and the supervisory boards of corporate enterprises are dealt with. Experience under this law is described also. An evaluation of the existing legislation suggests the conclusion that although the laws grant labor considerable rights with respect to enterprise management, ultimate decision and responsibility in West German enterprise remains in the hands of management.

The dissertation concludes with an attempt to define the impact on the economic organization of the scheme for the practice of codetermination ("full" codetermination) proposed by the German Federation of Trade Unions. It is suggested that implementation of this scheme would mean a partial expropriation of the rights of those persons who today control West German's industrial plant, but would have no affect on the property rights of those who today "own" but do not control this plant. In addition, it is maintained that the scheme implies a planned and managed economy in which the national income is functionally distributed through national collective bargaining. Finally, it is noted that "full" codetermination may be identified with "democratic corporatism," and that in the post-war ideology of West German Socialism it has been given the role previously assigned to public ownership.

623 pages. $7.79. MicA 55-982

EGG SUPPLY AND MARKETING PATTERNS IN THE NORTH CENTRAL STATES

(Publication No. 11,552)

Michal Ignacy Zawadski, Ph. D.
University of Illinois, 1955

The thesis grew out of a North Central Regional marketing project. The main analysis was based on data provided by two mailed questionnaires and the 1950 Agricultural Census. Its aim was to analyse and describe egg supply and marketing patterns in the Region in order to demonstrate the intraregional differences and evaluate the prevailing practices.

This Region produced about half of the nation's eggs, considerably more than it consumed. Therefore egg prices were below the U. S. average price, except in Michigan and Ohio.

Around large cities production was fairly intensive, but more regular the year round than in the other parts of the Region. Large commercial flocks were found alongside of medium and quite small flocks. Around Chicago, Milwaukee, Gary, Detroit, Cleveland and Cincinnati an egg marketing system has developed to take advantage of these large consuming centers. We designated these districts as a Metropolitan Marketing Area. One-third of the eggs were sold directly to consumers and institutions and another one-third to retail grocers and hucksters. The closeness of producer to consumer explains the relatively low proportion of eggs sold by farmers on a graded basis and the common practice of selling eggs sorted for size only. But most of the eggs sold by reporting dealers were graded by size and quality. Around other large cities in the Region these special market characteristics were much less pronounced.

The main supply areas with high sales per square mile and considerable surplus of eggs over local consumption were found at some distance from the main consuming centers, namely in northern and central Iowa, southern and central Minnesota, southern Wisconsin, northeastern Indiana and northwestern Ohio. These areas and also some with slightly lower output (located mainly in Michigan, Indiana and Ohio) were designated as Advanced Marketing Areas. A high percentage (over 50 percent) of these eggs were

sold on a graded basis and about two-thirds were picked up at the farm by the buyers.

A region immediately north of these areas was designated as a Fairly Advanced Marketing Area because grading and/or pick-up organization were more fully developed than in other areas of moderately intensive production.

As one moved south the proportion of eggs graded and picked up at the farm fell faster than what might be expected from the gradually decreasing intensity of production. Southern Iowa, all of Missouri and most of Illinois and Kentucky were designated as Underdeveloped Marketing Areas. A warmer climate – the enemy of egg quality, high seasonal variation in supply, and a considerable egg processing industry operating during the first six months of the year explain in part the smaller development of grade buying in this area. Here the scope for improving marketing practices seems to be greatest. In south central Nebraska and eastern and central Kansas climatic and market conditions were similar yet the proportions of eggs sold on a graded basis and picked up at the farm were considerably higher.

The small percentage of eggs sold on a graded basis in the extreme western and northern parts of the Region and the prevailing practices of farmers delivering the eggs to the buyers is explained by a low production level geared primarily to satisfying the small local needs. Retail stores acting as local assemblers bought the local surpluses.

While the egg marketing practices in the Region are rather well adapted to local conditions, an expansion of grading at the first level, and in some cases a shortening of the marketing channels would improve overall marketing efficiency. A greater commercialisation of production would make this task much easier. 270 pages. $3.38. MicA 55-983

ECONOMICS, COMMERCE AND BUSINESS

THE RAILWAY LABOR ACT OF 1926

(Publication No. 11,470)

James William Bennett, Jr., Ph. D.
The University of Florida, 1955

This dissertation is concerned with the federal regulation and control of labor-management relations in the railroad industry. In considering this legislation, the study attempts to accomplish several things. It traces the development of federal railway labor law, concentrating attention on existing legislation. It examines the major judicial decisions which have been rendered in relation to this statute and it analyzes the methods, policies, and experiences of the National Railroad Adjustment Board and the National Mediation Board. It also provides an account of recent railway labor disputes which have created national emergencies and resulted in the seizure of the railways by the federal government.

These subjects are examined in order to provide a basis for evaluating the effectiveness of existing railway labor legislation in resolving the problems of the labor-management relationship.

The fore-runner of existing federal railway labor law was enacted in 1888 and present legislation has been modified or amended on numerous occasions. It is apparent from a consideration of this evolutionary process that the existing statute is the result of extensive experience during which Congress has been almost continuously concerned with its improvement. Congress has sought to develop a statute which would receive the full support of the parties concerned and would equitably resolve the controversies which almost inevitably develop from the labor-management relationship. There is no indication that Congress has unduly favored any of the parties subject to the statute and it would appear that the procedures of the Act for the peaceful settlement of disputes should be quite successful.

A consideration of the judicial attitude towards this legislation indicates that the courts have not been a source of difficulty in implementing the apparent intent of Congress. The power of Congress to regulate the labor-management relationship has not been seriously questioned in many years and it is clear that this legislation and the methods and practices of its administrative agencies have received the approval of our judicial system.

The operational history of the National Railroad Adjustment Board indicates that it has not been too successful, especially in recent years. At this time, the volume of cases coming before the Board and the number of cases awaiting disposition is unprecedented. It would appear that the Board cannot resolve its difficulties without certain changes in its practices and policies and various recommendations have been made to alleviate these difficulties.

The National Mediation Board has been successful, generally speaking, in implementing its responsibilities under the Act. The substantive rules which the Board has established are fair and reasonable and the guiding policies developed by the Board have received very little criticism. The difficulties which have developed to trouble the Board have been due largely to the failure of the parties to comply with the spirit and the intent of the Act.

A consideration of certain recent labor disputes indicates that the difficulties encountered in resolving these controversies may be attributed to several factors – economic, political, and social. In general, the parties, especially the labor organizations, have not been satisfied to resolve their difficulties within the framework of the Railway Labor Act. These procedures have been exhausted and it has been necessary to utilize other methods to achieve solutions to these disputes.

It is concluded that the Railway Labor Act is basically sound. Several suggestions are offered to improve existing legislation and it is believed that

if the parties fully accepted these procedures, the statute is capable of equitably resolving any controversy that might develop.

374 pages. $4.68. MicA 55-984

SOME EFFECTS OF NONCONTRIBUTORY PENSION PLANS ON THE FINANCIAL POLICY OF CORPORATIONS

(Publication No. 11,221)

Keith Leroy Broman, Ph. D.
The University of Nebraska, 1955

The widespread adoption of pension plans in the past decade, stimulated by a climate of general prosperity, high corporate income tax rates and labor demands for fringe compensation, has posed problems affecting all segments of the American economy. The specific aspect of the pension problem examined in the present inquiry was a measurement of some of the effects of noncontributory pension plans on corporate financial policy. The primary source of data was the publicly available annual reports, prospectuses, and special reports of business firms. Of 275 corporations studied, 40 firms provided such data as to allow them to be subjected to careful analysis on the special problem. A brief analysis involving corporate pensions was made of the following: (1) the legal status as affected by tax laws and court decisions, (2) the indirect effects on the general interest rate and the securities market, (3) the aggregate pension data classified by asset size and industrial subdivision, (4) case illustrations of representative insured, trusteed and unfunded plans.

The firms studied closely were grouped as to benefit size, labor cost and industrial subdivision, and the tax adjusted pension costs were compared with earnings and dividends on common stock and with annual retained earnings. These comparisons measured the impact of pensions on corporate income. A second comparison was made by contrasting the working capital position of firms before pensions with the position after pensions as adjusted for income taxes. These tabulations measured pension impact on working capital. In both of these analyses, the experiences of approximately 40 firms were examined for the years 1949-1953 and, in addition, a long run analysis was made for two firms which had maintained pensions for several decades. Finally, past service liabilities and pension funds of reporting concerns were contrasted with capital structures. These relationships measured pension impact on permanent capital.

The impact of pension cost on the earnings of corporations was found to be less than might be expected. In few cases was this impact judged to be a serious financial problem. There was some evidence to indicate that the combination of high labor costs and pattern benefits might prove to be burdensome to the smaller firms. Even though benefits may be increased in the future, company costs can be relieved by the flexible factor of past service amortizations and by the cusion provided by the pension fund and its tax free accumulation of income. These points would seem to negate future complications for funded plans provided the company policy is intelligently directed to meet the problem. The impact of pensions on current and quick ratios was an insignificant factor even though 1949-1953 was a period which typically showed high working capital pressures. Contrasting past service liability to capital structures revealed that, although the percentage relationship was high in many cases, the problem was being worked out satisfactorily through flexible funding policies. The significant size of present and estimated future pension funds as compared to capital structures leaves little doubt that corporations have not presented pension data as adequately as the problem warrants. The inadequacy of the unfunded plan was demonstrated through case experiences and projections. This type of pension program has no flexibility in costs and would be especially dangerous during periods of economic stress. In conclusion, the pension plan of the firm was shown to be a particularly individualistic company policy which must be tailored to the specific concern and not adopted as a product of national labor trends with pattern benefits. 310 pages. $3.88. MicA 55-985

VALUATION OF LIFE INSURANCE ASSETS

(Publication No. 11,399)

Robert Stuart Cline, Ph. D.
University of Pennsylvania, 1955

Supervisor: Professor G. Wright Hoffman

Purpose

The primary purpose of this thesis is to examine and evaluate critically the methods used by legal reserve life insurance companies in the placing of values on the various assets which they hold. There is an attempt to review as many of the significant past and current discussions and valuation proposals as possible.

Significance of Asset Valuation

Only by a periodic comparison of the value of assets and liabilities by management and regulatory officials can the solvency of life insurance companies be tested. Policyholders' reserves which constitute the major liability item, are computed with a high degree of scientific exactness and represent fairly the collective claims of policyholders. It follows that the assets of the same company should be valued with as much care, and if possible exactness, as that used in valuing liabilities.

Approach

This thesis includes a discussion of the valuation

of all types of assets owned by the companies but the major emphasis is placed on bonds, stocks, mortgage loans and real estate. The various concepts of value, which are appropriate to the assets of life insurance companies, are reviewed and the current practices are considered with regard to the uses to be made of these values. Valuation of the assets of life insurance companies must be made with four essential purposes in mind: (1) current solvency, (2) current trend of solvency, (3) long-run safety of policyholders' commitments and (4) equity to all groups of policyholders. The current practices of valuation are measured against these essential purposes.

The development of life insurance asset valuation is also traced from its earliest regulation. There is a review of the mechanics of placing dollar values on the assets and an indication as to the relative importance of the various asset accounts.

Conclusion

The conclusions are divided into two groups; general and specific. The first category includes (1) a distinction in valuation practices among the various types of insurers, (2) inadequacy of past valuation practices, (3) advances in valuation techniques, (4) limits of regulatory valuation responsibility, (5) listing of some unresolved valuation problems.

The specific conclusions deal with the valuation of (1) bonds, (2) stocks, (3) mortgage loans, (4) real estate and (5) the asset reserve.

296 pages. $3.70. Mic 55-92

FACTORS AFFECTING CAPITAL REQUIREMENTS IN MANUFACTURING: AN EXPERIMENTAL CROSS-SECTION ANALYSIS OF SEVEN CONTRASTING INDUSTRIES

(Publication No. 11,400)

Hiram S. Davis, Ph. D.
University of Pennsylvania, 1955

Supervisor: R. T. Bowman

Statement of the Problem

Among firms commonly regarded as in the same industry, ratios of assets to sales often vary widely. Hence such ratios are deemed to be unsatisfactory measures of both the capital required in a given industry and its rate of use.

The purpose of this investigation has been: (1) to find out why ratios of assets to sales vary so widely among firms in the same industry, and (2) to see if the reasons discovered can be made the basis of subgrouping that would reduce the industry-wide variation sufficiently for the subgroup ratios to be useful measures of capital requirements and utilization.

Data and Method

The behavior of the ratios of gross fixed assets, inventories, trade receivables, and cash to net sales was studied for all firms (for which sufficiently complete financial statements could be obtained) that were devoted wholly or primarily to the production of agricultural machinery, electric motors, men's shirts, men's shoes, radios and related products, paperboard, and work clothing. The period covered was 1950-1951, except for men's shirts and paperboard for which the period was 1949-1950. These periods included at least one year of high sales for most of the firms studied. The industries and the period analyzed were determined by the use of data that had already been compiled in the course of a contract project at the University of Pennsylvania to provide information on capital requirements as part of the Technical Assistance Program of the Foreign Operations Administration.

The reasons for the behavior of the ratios were identified by arraying all of the ratios of a given kind for a given industry, and then examining the firms with ratios of similar size to see what characteristics they had in common that could reasonably account for the similar magnitude of their ratios. The reasons found were tested by seeing to what extent the variation would be reduced by using a given characteristic as the basis for subclassifying an industry. In addition contingency analysis was used to test the statistical significance of the subgroupings adopted.

Conclusions

(1) Fairly wide variations in ratios of assets to sales among firms usually regarded as in the same industry are likely to indicate the presence of some firms with characteristics associated with one level of capital requirements, and of other firms with those associated with other levels.

(2) Ratios of assets to sales can be used to measure the capital requirements of an industry and differences in rate of utilization within the industry, provided the firms involved have been appropriately subclassified by the characteristics within the industry accounting for major variation in the ratios.

(3) There is no single differentiating characteristic that explains the variations among firms equally well for all classes of asset ratios, or in all manufacturing industries.

(4) In so far as there is any tendency for asset ratios to increase with size of firm, there is no single explanation for this tendency that applies with equal force in every manufacturing industry – certainly this tendency is no indication per se that the larger firms use production methods requiring more capital than those used by the smaller firms.

264 pages. $3.30. MicA 55-986

ADAPTABILITY OF ACCOUNTING TO DIFFERENT SOCIAL SYSTEMS

(Publication No. 11,499)

Edwin Joe DeMaris, Ph. D.
University of Illinois, 1955

Accounting adaptability is considered to mean accounting's ability to accommodate itself to social systems having differing political ideas, social goals, and economic institutional alignments, without loss of usefulness or significance of accounting data. By accounting is meant enterprise accrual accounting as it is found in the United States. Accounting's primary function is that of providing significant and useful data about business enterprises and so, if in its adaptations to the needs of enterprises operating under differing social and economic settings, accounting data attains its established level of significance and usefulness, presumably there has been no limitation on its adaptability to its new environments.

The thesis problem presents itself because of the present observable trend away from free market economies and towards managed or controlled economies. The upsurge of the latter has been accompanied by the imposition of extensive limitations upon the free market apparatus; it is today seldom permitted the ascendency it commonly attained in the nineteenth century. And in some economies other antecedents of the kind of social systems in which enterprise accrual accounting was developed have been modified or virtually eliminated from the social and economic matrix. Thus the political, social and economic background conditions for accounting use have changed and at present the raw material of accounting – priced-exchange transactions – is being produced under a variety of differing conditions found among the modified capitalistic and planned economies in the world today. This development provokes the central question of the thesis problem which is, whether changing or differing antecedents of priced-exchange transactions may have an effect upon the significance and usefulness of accounting data itself.

It follows that a considerable portion of the thesis is devoted to the matter of how prices are determined under various systems of social and economic organization. Social systems considered in this regard included the United States, Australia and New Zealand, Great Britain, Nazi Germany, and the Union of Socialist Soviet Republics. The attempt was made to ascertain the role of accounting within each of the economies mentioned and to appraise the usefulness and significance of the accounting data provided therein.

On the question of the adaptability of accounting to modified capitalistic and planned economies it is apparent that accounting has more than survived the institutional changes wrought in those social systems. It remains to be demonstrated, however, whether accounting is fully adaptable in the sense defined in the thesis unless there is extant in the social system in which accounting is being used effective exchange of the type characteristic of a free market economy.

213 pages. $2.66. MicA 55-987

ACCOUNTING THEORY AND PRACTICE CONCERNING THE USE OF NET WORTH RESERVES, 1900-1950

(Publication No. 11,539)

Donald Harvey Skadden, Ph. D.
University of Illinois, 1955

This study is primarily an historical analysis of accounting for net worth reserves from 1900 to 1950 in America. The emphasis is on the nature and use of the accounts, how they were created, and their final disposition. The final chapter includes the author's proposed integrated theory of net worth reserves.

The historical portion of the thesis is in three basic divisions: (1) Case studies of the reserve accounting of United States Steel Corporation from 1902 to 1950, International Harvester Company, 1907-1950, and Swift and Company, 1916-1950. These companies were chosen because they have used reserves extensively, and have published reasonably informative reports for many years. (2) A summary of general reserve theory for the fifty years. (3) A discussion of eleven individual types of reserves including both their theoretical developments and examples of their uses in actual practice. The accounts so discussed are reserves for: general contingencies, insurance, war and postwar operations, inventories, high cost additions to assets, sinking funds, asset expansion and improvement, treasury stock, taxes, repairs and maintenance, foreign operations, and employee pension funds. The information for all three sections came from a study of annual reports plus an extensive review of accounting and finance literature from 1900 to the present.

The historical study of reserve accounting led to the development of an integrated theory of net worth reserves. It is contended that the net worth accounts should not be considered individually, but should be part of an integrated group of accounts. Surplus reserves can be very useful if used properly. Surplus reserves should be divorced completely from capital surplus and identified exclusively with earned surplus. The reasons for retaining earnings, as manifested by the many different surplus reserves, can be summarized in six basic categories. These are, earnings retained for: (1) possible future needs, (2) future asset expansion, (3) debt or preferred stock retirement, (4) other legal or contractual restrictions, (5) present use in business operations, and (6) dividend stabilization. The total of these categories should be the total of earned surplus. The decisions to retain income are primarily managerial, but this is an area in which accountants can render valuable service in supplying information

necessary to make such decisions and in assisting in the reporting of those decisions. In the administration of surplus it is desirable for management to analyze earned surplus periodically, and reappraise the need and necessity for each of the six categories. In retaining earnings it is important that these categories be as mutually exclusive as it is possible to make them. In reporting, it is desirable to follow what might be called an "all or nothing" policy. When just part of the surplus is indicated as "reserved" the immediate implication is that the unreserved portion is available for immediate distribution. It is more desirable either to show the earned surplus in one figure, or to break it down completely and show all the basic categories that apply in the particular case.

271 pages. $3.39. MicA 55-988

THE DEVELOPMENT OF WORK MEASUREMENT SYSTEMS IN THE DEPARTMENT OF DEFENSE

(Publication No. 11,443)

Samuel Mack Wilson, Ph. D.
University of Pennsylvania, 1955

Supervisor: Robert P. Brecht

Statement of the Problem

The Military Services of the Department of Defense are involved in developing and implementing separate systems for measuring and evaluating the utilization of either part or all of their manpower on a formal basis. The purpose of this study is to determine the requirements of the work measurement systems being developed and applied in the management of the nation's military manpower and to make a general appraisal of their procedural aspects. The analysis comprises five inter-related aspects:

1. A general statement of the nature and basic characteristics of a system of work measurement,
2. The historical development of the work measurement systems in the Military Services,
3. A detailed description of the organizational requirements, supporting procedures, and technical requirements for the development, installation, and use of the particular application of work measurement,
4. An appraisal of the essential features of the work measurement systems, and
5. Conclusions pertaining to the current status and future potential of work measurement in the Military Services.

Method of Study

The method of approach and plan of presentation used in this study are designed to present a factual account and a sound appraisal of the work measurement systems being used by the Military Services. The method involved examining the literature pertaining to the subject and presenting experiences of the military with work measurement as derived from published studies, military documents, personal interviews and letters, and conferences with management personnel of the Army, Air Force, Navy, and Marine Corps. The experiences which the author has had in helping to develop and implement the work measurement system for the United States Marine Corps were also utilized in making the study.

Results

Essential requirements in designing, installing, and utilizing work measurement systems in the Military Services were found to be: (1) establishing the organizational needs, (2) determining the type of work measurement system to be used, (3) deciding whether to standardize the work prior to establishing a work measurement system, (4) selecting and defining the areas for measurement, (5) selecting the levels for measurement, (6) determining and defining measurement units, (7) deciding on the time unit, (8) developing uniform terminology, (9) developing adequate procedures and instructions, and (10) establishing and using performance standards along with other methods for utilizing the work measurement systems.

The appraisal points out fundamental strengths and weaknesses of the work measurement systems being used by the Armed Services. The basic features selected for treatment are: (1) the internal organization, (2) the type of work measurement being used, (3) the reporting methods, (4) the methods used in implementing the systems, (5) the methods used in developing standards, and (6) the accomplishments of the systems.

Conclusions

The work measurement systems of the Military Services have been developed in response to recognized needs in military management which have been emphasized in the last several years. These needs arose because of the fundamental problems associated with planning, allocating, controlling, and utilizing manpower. These manpower management problems are especially important during the period when the United States has to maintain a large defense establishment.

Work measurement, when integrated with other techniques for management improvement, e.g., performance budgeting, cost accounting, work simplification, and organization and method studies, is making it possible to meet the basic demand for sound manpower management. The present-day management of manpower requires the use of pertinent facts. Work measurement not only presents the facts in terms of statistical data, but also provides for the evaluation of past performances and a basis for determining future requirements.

The work measurement systems of the Department of Defense are still in the growth stage and improvements are needed. However, the use of the systems is reflecting a significant change in the practical philosophy of government. The basic philosophy of "that government is best which governs least" is changing to a more positive philosophy of "that government is best which serves most." 293 pages. $3.66. Mic 55-93

ECONOMICS, FINANCE

HIGHWAY NEEDS AND THEIR PUBLIC FINANCING IN THE POSTWAR PERIOD

(Publication No. 11,493)

Philip MacDonald Carroll, Ph. D.
University of Illinois, 1955

At the end of World War II, the nations' highway system was not only badly in need of repair, but much of it was functionally obsolete and required reconstruction if it were to handle modern traffic safely, swiftly, comfortably, and economically. In the years following the war, highway needs have been intensified by a rapid increase in motor vehicle registrations and travel, both of which were completely underestimated in the early postwar years, and of increasing costs of construction and maintenance. In 1950, the dollar cost of correcting the existing deficiencies on all roads and streets was estimated at $41 billion.

The evidence from empirical tests, statistics, and other research establishes that this outmoded highway system is uneconomical and may be exacting extra costs of two, three, or more billion dollars a year from motor vehicle operators. In addition to the direct savings that could be made from modernization, increased land values, lower productive costs, and greater national security and cohesiveness would accrue to the economy as a whole from better roads so that a definite economic case is made for highway modernization.

Recognizing the problem, many states have made engineering surveys of their highway needs along with studies as to the ways in which the needs could be financed. The surveys and studies undertaken by twenty states and the legislative action to implement proposed financial plans were analyzed to determine how well these twenty states were meeting these highway needs.

Of the twenty states, California, Maine, Mississippi, Ohio, Oregon, Virginia, and Washington will adequately meet their needs, as defined by the studies, in the next ten to fifteen years under the programs enacted up to early 1954. The Iowa, New York, and Pennsylvania, programs were somewhat less adequate than the first seven. Michigan and Nebraska were given a fair rating and Florida a poor to fair rating. Colorado, Connecticut, Illinois, Kansas, Montana, North Dakota, and Utah had programs that would require twenty years or longer to meet their estimated highway needs.

No completely new revenue sources were being used. The Iowa Legislature did adopt as part of their plan the use of general revenue by allocating ten per cent of the sales tax to highway use. The gasoline tax and registration fees, however, were still the main source of revenue. Only New York and Florida have not raised their gasoline tax in the postwar years. Eleven of the states increased registration fees to some degree. Mileage taxes, bond issues, and toll roads were being used as increasingly popular revenue sources.

The study shows that most of the states which are not adequately meeting their needs have the resources to do so. It may not be politically possible for them to do so, but it is economically possible. Seven of these states could raise their gasoline tax one cent and finance a bond issue to accelerate modernization.

This record may be bettered over the next few years as interest and activity remain high at the state and federal levels. The problem of equity of highway taxation, especially between automobiles and trucks, remains acute and increases as gasoline taxes are raised, and the imposition of the ton-mile taxes by important states such as Ohio has begun to raise new questions and problems.

217 pages. $2.71. MicA 55-989

AN ECONOMIC CHARACTER CLASSIFICATION OF THE BUDGET OF THE UNITED STATES GOVERNMENT

(Publication No. 11,874)

Ching-wen Kwang, Ph. D.
Syracuse University, 1955

The economic effects of government finance have been increasingly recognized since the depression of the 1930's. In the post-war period, national and international interest in the economic development of underdeveloped countries has provided further impetus for the study of government policies in economic stabilization and development. The government budget must, in such cases, serve as an instrument for the formulation of full employment and developmental programs.

The effective formulation of fiscal policy, however, must be based on accurate information on government activities reported in a form useful for economic analysis. It is only through appropriate classification of budgetary data that relevant information for economic analysis can be provided. The conventional classification of budgetary accounts, designed as it is for executive management and legislative control, is inadequate for this purpose. What is needed is a reclassification of government accounts in terms of economically significant categories that will reveal information necessary for appraising the impact of government programs on the economy.

Problems of structure and classification of government accounts have been discussed estensively in the United Nations publication, Budgetary Structure and Classification of Government Accounts. The present study is an application of the principles developed therein to the budget of the United States Government. To achieve maximum usefulness, an economic character classification of government transactions should be related to the national income or social accounts. When so designed, the impact of government programs on the economy can be readily gauged.

Chapter I presents a brief exposition of the system

of national income accounts used by the Department of Commerce and the aggregate measures of income and production currently published. A more detailed discussion of the treatment of government transactions in national income accounting is presented in Chapter II. With this background, it is then possible to see the relation between the national income accounts and the system of accounts for government transactions based on an economic character classification to be developed later.

The system of accounts for an economic character classification of federal government activities for the fiscal year 1953 is developed in Chapter III. Government activities are classified into three sectors: general government, public enterprises, and trust funds. For each sector a current account and a capital account are set up. The over-all financial result of all government operations is presented in a consolidated account. To indicate the uses of an economic character classification, a second consolidation showing the net additions to private sector income is presented. A consolidated cash deficit is also derived and reconciled with the excess of budget cash payments to the public. The set of accounts can be used to derive several balancing items for purposes of economic analysis.

An economic character classification of government accounts will directly relate budget data to the national income accounts. This is illustrated with the derivation of federal government purchases of goods and services, as defined by the Department of Commerce, from the individual accounts. A fully-developed system of economic character classification would be an integral part of a system of statistical reporting and presentation of economic activities. When competently prepared by the central statistical, or budget office, and incorporated as part of the budget document, an economic character classification would provide the materials necessary for a continuing analysis, both outside and inside the government, of the effects of federal fiscal activities on the economy as a whole.

256 pages. $3.20. MicA 55-990

A COMPARATIVE STUDY OF THE ILLINOIS RETAILERS' OCCUPATION TAX AND THE IOWA RETAIL SALES AND USE TAXES

(Publication No. 11,518)

Leonard Dale Maliet, Ph. D.
University of Illinois, 1955

Retail sales taxes in Illinois and Iowa (and in twenty other states) have become the single most important source of revenue for state governments. The purpose of this study is to examine and analyze the major features of these taxes in Illinois and Iowa.

Sales taxes were enacted in Illinois in 1933 and in Iowa in 1934 at a time when State revenues were falling, property tax delinquencies were increasing, and relief problems were critical. First adopted as temporary measures, these taxes were later made permanent parts of the States' fiscal structures as State revenue requirements to finance such functions as old age pensions, school aid, and property tax relief increased.

A logically consistent retail sales tax should apply to all goods and services sold to consumers, but exclude all those sold to producers. With the exception of goods which become physical ingredients, the taxes in Illinois and Iowa generally apply to sales to producers. On the other hand, consumer services (with exceptions in Iowa) are generally excluded. There appears a widespread feeling among legislators and administrators that a tax on services is of a different nature than that on sales of commodities. While some administrators and legislators hold that the tax should logically cover producers' goods, many defend the taxation of these goods on a basis of revenue and administrative considerations. Exemptions are limited in both States. Illinois encounters legal difficulties; Iowa has been reluctant to make exemptions because of revenue and administrative considerations. Typically, exemptions create administrative and compliance problems. There is little economic basis for some exemptions which are granted such as, for example, those to governments or those of commodities subject to special State excises.

The Illinois tax is imposed on the occupation of selling; the Illinois courts have interpreted the tax strictly as an occupational levy. Construction contractors, repairmen, producers of specially designed products, and others have been held to be engaged in service occupations and excluded from the tax. Supplies sold to these persons which are later transferred to customers in conjunction with services are also excluded on the theory of resale. This interpretation has resulted in discrimination, additional compliance and administrative problems, and loss of revenue.

While interstate commerce restrictions present problems in state administration of sales taxes, these problems should not be overemphasized. Sales or occupation taxes reach many interstate transactions. Complementary use taxes can effectively reduce the problems in cases such as motor vehicles and business purchases and in instances where the out-of-state vendor can be required to collect the tax. Although merchants in areas adjacent to other states, particularly non-sales tax states, face problems, these, in general, do not appear great. Extension of state powers to allow the importing state to impose its tax would be helpful. This would not result in discrimination against interstate commerce.

Although effective administration of state sales taxes requires extensive field work in auditing records and checking delinquents, costs of administration are not exorbitant. Costs expressed as a percentage of revenues are approximately 1.5 per cent in Illinois and somewhat less in Iowa. While Illinois and Iowa have developed sizable field programs, these should be extended. Extension would result

in a net increase in state revenues in addition to greater equality in the application of the tax.

As retail sales taxes are assuming greater importance in state and local fiscal structures, greater emphasis should be given to their structure and administration. Both economic and practical considerations should be emphasized.

302 pages. $3.78. MicA 55-991

INVESTMENT IN COMMERCIAL REAL ESTATE BY LIFE INSURANCE COMPANIES

(Publication No. 11,434)

Harold Wayne Snider, Ph. D.
University of Pennsylvania, 1955

Supervisor: G. Wright Hoffman

In recent years commercial real estate has provided a new outlet for life insurance funds. This dissertation is a study of that investment outlet.

There are two basic philosophies of investment in commercial real estate: one is the credit philoslphy; the other is the property philosophy. The credit philosophy emphasizes the earning power of the lessee; the property philosophy emphasizes the earning power of the property. Differences in these philosophies become evident in the types of property acquired for investment, methods followed in acquisition, and terms under which property is leased.

The activities of the twenty life insurance companies which have invested the largest sums in commercial real estate are analyzed in this work. Statistics on length of leases, renewal and repurchase options, and rentals are presented in order to give an indication of prevalent attitudes and philosophies.

The development of legal restrictions on the holding of income-producing real estate, their removal, and the current status of regulation are also discussed. 159 pages. $1.99. Mic 55-94

ECONOMICS, HISTORY

THE STRUGGLE FOR CONTROL OF THE FLORIDA CENTRAL RAILROAD (1867-1882): A CASE STUDY OF BUSINESS ENTERPRISE IN POST-CIVIL WAR FLORIDA

(Publication No. 11,472)

Paul Edward Fenlon, Ph. D.
The University of Florida, 1955

The Florida Central Railroad, along with many other railroads in the United States, was influenced profoundly by the activities of promoters during the post-Civil War era of "high finance" and reckless railroad building. A year before the war it had been built to serve as the eastern sixty miles of a cross-state railroad transportation system that traversed the most rapidly developing section of Florida. By the end of the war the Florida Central was in very poor physical and financial condition, and the destruction of the plantation system had made its redevelopment appear unlikely. The original developers of the railroad, like most Southerners, had been impoverished by the war and were unable to exert significant influence in the Reconstruction government of Florida. The stage was set for the entry of two of the South's most notorious post-Civil War railroad promoters, George W. Swepson and Milton S. Littlefield. These promoters, with the cooperation of many legislators and state officials, started in 1867 the "Swepson-Littlefield Fraud," the greatest railroad financial legerdemain in the history of Florida. As a result of their activities, there was a fifteen year long struggle for the control of the Florida Central. During this struggle many lawyers, bankers, businessmen, judges, speculators, and government officials became involved in the affairs of the railroad.

One of these men was Captain Edward M. L'Engle, a Jacksonville lawyer whose initial contact with the railroad occurred through his acceptance of George W. Swepson as one of his clients. L'Engle, a member of one of ante bellum Florida's most influential families and a veteran of the Confederate Army, soon realized that Swepson and Littlefield intended to use the Florida Central in some financial manipulations which were designed to do no more than secure large personal gains for themselves. He then turned his attention to trying to keep the railroad out of the hands of Swepson, Littlefield, and other opportunists. L'Engle's efforts to make the Florida Central more than a pawn in a game of "high finance" led him into open and bitter conflicts with the Republican political leaders of the state, and brought him into close contact with numerous bizarre events in the fifteen year long struggle for the control of the railroad. One of these events was the action of an investigating committee of the Florida Legislature in accusing Governor Harrison Reed of conspiring with Swepson and Littlefield to defraud the State of Florida of several million dollars. Another occurrence was the acceptance of a bogus $100,000 supersedeas bond by an Associate Justice of the United States Supreme Court.

The final settlement of the controversy in which these and other events occurred came when, in accordance with a decision of the United States Supreme Court, the Florida Central was sold to the head of an English syndicate of speculators who then sold it to Henry B. Plant, the principal developer of much of central and southwestern Florida.

An account of the struggle for the control of the Florida Central is an account of litigations, ambitions, failures, and corruption during one of the most hectic periods in the long and eventful history of Florida. It is a case study of the survival of a business

enterprise in the chaotic economic and social conditions that followed the Civil War, and it is an illustration of the excessive influence of Reconstruction government in business during a time that is often referred to as the heyday of capitalism in the United States. 202 pages. $2.53. MicA 55-992

ECONOMICS, THEORY

PESSIMISM IN ECONOMIC THOUGHT

(Publication No. 11,411)

Russell Albert Headley, Ph. D.
University of Pennsylvania, 1955

Supervisor: Raymond T. Bye

"Pessimism In Economic Thought" is an analysis of pessimistic doctrines beginning with those formulated by Thomas Robert Malthus and David Ricardo and continuing to modern times, concluding with the prediction of capitalism's dissolution by Joseph Alois Schumpeter.

Since the thesis is organized around ideas, economists who espoused more than one pessimistic conclusion appear several times. The men whose ideas are examined did not consider themselves pessimists, but were trying to understand economic phenomena in order to solve current problems. Pessimistic theories of economists are developed even though the writer may have embraced other concepts of an optimistic nature.

Pessimism is defined to include doctrines which lay stress upon scarcity and conflict, emphasizing the niggardliness of nature and the conflict of interests, which seem to be inherent in the capitalistic system. Theories are included also which take a gloomy view of the future, predicting the inevitability of a stationary state or secular stagnation. Those that deny the efficacy of automatic adjustors to keep the economy in a state of equilibrium at full employment are considered pessimistic, as are those that predict the ultimate dissolution of capitalism.

An attempt is made to discover reasons for the gloomy forebodings and the extent of the influence of pessimistic tenets upon the development of economic thought and the formation of public policy. Contrasts and similarities of the concepts are examined, as well as any continuity of theme that seems to exist.

In chapter two, three types of conflicting interests theories are studied, portraying the opposing interests of landowners and capitalists, the strife between the capitalist-employers and the workers, and a conflict in interests between the individual and society. It is discovered that these ideas are based largely upon the assumption of nature's niggardliness and the struggle that occurs in the distribution of a total product insufficiently great enough to satisfy the desires of an everexpanding population. A fixed quantity of land, cultivated on the principle of diminishing returns, is set over against increasing numbers. Scarcity, conflict and exploitation are examined as they were portrayed by Malthus, Ricardo, Sismondi, Lauderdale, Rae, J. S. Mill, Marx, and Veblen.

Chapter three analyzes the gloomy prediction of the inevitability of a stationary state, as this concept is found in the writings of Malthus, Ricardo and J. S. Mill. This tenet is investigated fully, showing in each case the basic assumptions, the line of reasoning, and significant points of similarity and contrast.

Chapter four examines various theories that deny the adequacy of automatic adjustors to promote full employment. Malthus' concept of a lack of ineffectual demand is studied and contrasted with the Keynesian conclusion of an insufficiency of total aggregate demand. Hobson's underconsumption theory, serving as a connecting link between the ideas of Malthus and Keynes, is analyzed critically. The ideas of Sismondi and Hansen are developed, also. This chapter deals with overproduction, overinvestment, underproduction, underinvestment, and underconsumption. Continuity of theme, significant differences in assumptions and conclusions are stressed, as is also the influence upon economic thought and public policy.

Capitalism's dissolution, as it is advanced in the writings of Marx, Veblen, and Schumpeter, is the subject matter of chapter five. This concept is built largely upon the assumption of conflicting interests and is darkly pessimistic in that capitalism is portrayed as containing the "seeds of its own destruction."

This dissertation discovers that pessimistic conclusions result from a point of view that emphasizes scarcity, conflict and the imperfections of the capitalistic system rather than man's ability to overcome obstacles. Although the pessimistic tenets have, in most cases, depressed conditions as a background, they are the product of a state of mind that expects no change for the better, discounting man's ability to conquer nature's niggardliness.

210 pages. $2.63. Mic 55-95

SECULAR STAGNATION IN A MATURING ECONOMY

(Publication No. 11,016)

Arnold William Sametz, Ph. D.
Princeton University, 1951

Neither the Keynee/Hansen nor a classical approach to the problem of secular stagnation in a maturing economy is acceptable. The classical model, whether of the 18th, 19th century (Smith, Ricardo, the Mills) or of the 20th century (neoclassicists: Pigou and Knight) is, on a priori grounds,

unsuitable to the problem. By postulating perfect flexibility of prices or perfectly synchronized savings – investment relationships, the "Classicals," no matter how sophisticated the analysis, assume away in an unacceptably unrealistic fashion the very problem we are concerned with, viz.: the possibility (and then probability) of chronic underemployment or deep, protracted depressions with weak booms in the modern capitalist economy. The Ricardians, for example, assume that as an economy matures, the rate of profit and interest (and hence investment) declines but the perfectly harmonious fall in accumulation (savings) (or rise in consumption Pari Passu) is also postulated. Consequently, for the Ricardians the mature economy or stationary state with continuously full employment (and in which there is no accumulation and no net investment or the propensity to consume is unity) is ushered in smoothly. Although Pigou concedes that perfect synchronization between savings and interest rates cannot be postulated realistically, he demonstrates that nevertheless continuous full employment equilibrium will be maintained if prices and wages are perfectly flexible. But the latter assumption cannot be granted. (Nor can we accept Knight's assumption that investment opportunities are limitless at sufficiently low interest rates.) Rather, a realistic model must postulate a Keynesian rather than a classical view of the propensity to save (i.e., that savings may be made for reasons other than the receipt of interest income – that savings can be positive at the lowest interest rate conceivable: zero) and that prices and wages are to some degree imperfectly flexible. Therefore, basically classical models (always exempting Malthus) but not Keynesian models are discarded on a priori grounds.

However, the Hansen/Keynes stagnation model is also analytically unsound and empirically flimsy. Hansen's thesis turns essentially on one characteristic of the maturing economy: the declining rate of absolute growth of population. Population trends and forecasts for U. S. and England indicate that some population growth rates have indeed declined and that an absolute decline in absolute population is quite likely, (assuming the fertility trend – the crucial factor in forecasting – is not reversed or that the current population upsurge is a temporary abnormality). But the probable date of onset of such absolute decline is much farther in the future than postulated and the extent of expected absolute decline may be very slight. (Note that the Keynes/Hansen school has developed what is in essence a unique theory of population which takes its place alongside the Malthusian and optimum theories of population.) In any case Hansen's thesis turns on the presumed stagnating effects (i.e., investment depressing and saving promoting effects) of declining (and aging) population. We find, on balance, no case empirically or analytically for propensities to save to rise in a maturing economy, e.g., savings may rise owing to shrinking family size but fall owing to the aging of the family. Nor do we find that the presumed shifts in the composition of demand of an absolutely declining population necessarily depress investment whether stress be placed on the structural argument: (volatility of demand and hence riskiness of investment, depressed entrepreneurial expectations, or declining mobility both absolutely and relative to needs), or on the capital-saving argument: (the goods demanded, e.g., services not housing will require absolutely less investment per unit for their production.) Thus the Hansen/Keynes thesis must be discarded. The burden of its argument rests almost primarily on the presumed stagnating effects of declining population for which we found neither the analytical nor the empirical case strong. Moreover, actual future population movements may possibly be such as will achieve stability or slow growth without any period of decline. Nevertheless, a model of modern capitalism maturing in the sense of growing wealth and productivity rather than maturing in the population sense can be developed.

A model combining the basically realistic Keynesian assumptions (in regard to the savings-investment process and imperfectly flexible prices) and the "dynamic" character of the investment process itself as developed recently by Domar, Kalecki, Harrod, and Hicks, provides a model of convincing power and realism. This Keynes/Domar model encompassing as it does both the spasmodio income generating effects and the continuous output generating effects of investment reveals the realism of the probability of secular stagnation rather than the unproven inevitability implied in the Hansen thesis or the unrealistic impossibility of secular stagnation in the classical model. Fulfillment of the Keynesian conditions alone merely ensures short run full employment; in the long run (and we are concerned with secular stagnation) employment is a function of productive capacity as well as income. The likelihood of secular stagnation is determined by the outcome of the race between the rates of growth of capital accumulation and that of income. Rapid accumulation of capital will not induce secular stagnation if the accelerator and multiplier interact so as to keep income rising and investment rising in succession. Thus the secular stagnation problem is handled both most realistically and elegantly in the Keynes/Demar model where the crucial factor is the rate of increase of income (investment) required to avoid secular stagnation which rate is equal to the product of the MPS (χ) and the average productivity of investment (σ); or $r = \chi\sigma$. If there is no reason or evidence (and we find none) for expecting a declining MPS (or a bigger multiplier) nor a smaller σ (increased deepening), nor a weakening accelerator, then the avoidance of secular stagnation (the maintenance of the requisite rate of growth of income) depends on the rate of increase of the volume of spontaneous investment. But even if the required rate of growth can be achieved, it probably will not be achieved if capital junking is inhibited (the $S > \sigma$ condition); the latter depends essentially on the extent of monopoly power extant and the deepening quality of investment.

Thus the index of probability of secular stagnation or chronic unemployment depends not on population

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

trends but principally on the nature and volume of technological advance, the extent of competitiveness, and the "social atmosphere" — all of which determine the spontaneous investment rate. The dynamic model, in short, reveals that, unless technological advance falters or "shallows" (and no proof of this was found), the probability of secular stagnation is essentially determined by the nature of the institutions of the capitalist state considered. But a wealthy economy is marked by two characteristics which make full employment difficult to maintain: vast productive capacity and a high marginal propensity to save; the latter requires that investment be large at any point in time and the former that investment rise at compound interest rates over time. Consequently not an overwhelming or extraordinary set of institutional rigidities but something less may be all that is required to induce a state of secular stagnation.

382 pages. $4.78. MicA 55-993

EDUCATION

EDUCATION, GENERAL

THE POLICY OF THE NATIONAL EDUCATION ASSOCIATION TOWARD FEDERAL AID TO EDUCATION (1857-1953)

(Publication No. 11,235)

Albertina Adelheit Abrams, Ph. D.
University of Michigan, 1955

The aim of this study is to determine the origin, nature, and causes of the policy of the National Education Association toward federal aid to education. While several publications of various phases of N. E. A. history exist, no one of them has been concerned with an analysis of the policy of the N. E. A. since its origin.

The basis for N. E. A. policy in the early years seems to have been largely humanitarian and idealistic. It confirmed the belief that the nation could not be strong without a well-educated public. Since, however, the N. E. A. was constrained in order to build and hold a large membership of teachers, it had to offer a more practical program. After World War I, the N. E. A. tended to emphasize the increase in financial rewards for teachers if federal aid were obtained. Money obtained from dues was largely the main source of funds for the N. E. A. For this reason drives for increased membership were closely related to the federal aid movements.

The source materials used in the study were the letters, minutes, and documents of the Commission on the Readjustment, the Joint Commission on the Emergency in Education, the Educational Policies Commission, and the Research Division of the N. E. A. The Proceedings and the Journal, publications of the N. E. A., as well as interviews with former Commission members, were also used.

This study, which covers nearly a century of N. E. A. history, is divided into five related, but somewhat different phases. During the first period, from 1857-1870, the N. E. A. concentrated on obtaining national recognition for the teaching profession through the establishment of a national bureau of education at Washington, D. C. From 1870-1917, the N. E. A. crystallized its federal aid concept to the extent that it advocated federal participation in education through funds received from land sales or direct federal grants, but only on the condition that there be no federal control of the public schools. Between 1917-1932, The N. E. A. reached its height of federal aid activity by sponsoring the Towner-Sterling bills. During the depression, N. E. A. support of federal aid was mainly confined to the procurement of federal emergency grants for distribution through government agencies already in existence. Recent N. E. A. proposals have been based on two principles: 1) that federal aid be given as a direct grant to each state on the basis of school-age population, and 2) that all states be given federal aid in proportion to local contributions and income.

These general conclusions can be drawn from the study: 1) Henry Barnard originated the concept of a national bureau of education to be supported by federal funds. This measure was adopted by the N. E. A. in 1858. This action represents the initial interest of the N. E. A. in federal aid to education. 2) During periods of emergency, N. E. A. policy was both crystallized and accelerated. In 1919 and again during the depression, policy developed as a result of N. E. A. surveys which showed that the high job mortality rate of teachers was related to low salaries and status. Out of these facts grew the N. E. A. belief that state and local support were insufficient to finance public education. 3) Through its emphasis on federal aid for public schools, the N. E. A. has spoken for the teaching profession to the effect that the education of the future depends in part on sufficient financial support to assure the teachers of the nation an adequate livelihood.

292 pages. $3.65. MicA 55-994

A STUDY OF THE READABILITY OF GENERAL BUSINESS TRAINING TEXTBOOKS

(Publication No. 11,577)

George W. Anderson, Ed. D.
University of Pittsburgh, 1955

This is a study to determine the grade placement of 28 general business training textbooks by applying two readability formulas. The Yoakam formula and the Revised Flesch formula were applied to 15 pages of each textbook to determine if these textbooks were properly graded in order that the majority of ninth-grade pupils could read them with understanding. A list of business words was checked by a competent jury of 20 leaders in business education to determine which words should be included in the vocabulary study of ninth-grade students in general business training.

The results of the study indicate that further evidence is needed to determine whether the Yoakam formula or the Flesch formula is more accurate in studying readability of content subjects in the higher grades. Both formulas use vocabulary in determining reading difficulty and, in this research, there is an average difference of 2.4 grades between the two formulas in the grade placement of the textbooks studied. If the results of the Flesch formula are accepted as reliable, then 18 of the 28 textbooks may be considered too difficult for the ninth-grade pupil. If, on the other hand, the results obtained by using the Yoakam formula are accepted as reliable, two books may be considered too difficult and seven textbooks may be considered too easy for the ninth-grade pupil. It would seem probable that the frequency with which a word is used, as employed by Yoakam, is more reliable in predicting reading difficulty than is the sentence length and the number of syllables found in a passage. It seems probable that the Flesch formula does not indicate grade levels with accuracy. The reliability of the grade placements of the Revised Flesch formula needs to be established in order for it to be useful to those investigating readability of reading materials used in the secondary school.

Of the 531 words submitted to the jury, only 51 received less than 10 affirmative jury votes as words having a technical meaning. Of a total of 6,374 words found on 420 pages of textual material surveyed, only 531 words, approximately 8.3 per cent, having a Thorndike rating of four or higher had a business definition in the dictionary.

These 531 terms will, no doubt, appear in other textbooks in business education in grades 10, 11, and 12. These words represent ideas or concepts that are current in business usage. They must be learned by the pupil in order that he may acquire the true picture of business and its responsibilities. An understanding of these business terms will aid the pupil to become economically competent.

There seem to be many nontechnical words in the textbooks studied which could conceivably cause reading difficulty. On the basis of the data accumulated in the present study, it is believed that nontechnical words cause as much reading difficulty as do the technical words. It is the responsibility of teachers of general business training to include these words, as well as the business words, in vocabulary study.

One significant fact obtained from this study is that both formulas measure the readability of each textbook in a uniform direction; that is, each measures the same book as difficult or easy as the case may be. If the Flesch technique could be adjusted to permit precise grade placement, then the Flesch formula and the Yoakam formula might produce similar results.

It would appear that the publishers are putting emphasis on factors of readability other than vocabulary. It is true that a readability formula is not a formula for writing, but it does provide a procedure for predicting ease of comprehension for the average reader in the grade for which the material is to be used.

It would seem important for the teachers of general business training to prepare study-type reading lessons which will include both technical and nontechnical words. A better understanding of the concept illustrated by each word should improve achievement in the subject by all pupils. The effect on achievement in general business of reading lessons should be studied.

83 pages. $1.04. MicA 55-995

THE DUTIES OF CERTIFIED COUNSELORS IN THE PUBLIC SCHOOLS OF MISSOURI

(Publication No. 11,562)

Lucius Edward Guese, Ed. D.
Washington University, 1955

Chairman: Dr. Nathan Kohn, Jr.

It was the purpose of this study: (1) to determine the duties and functions performed by certified counselors in the State of Missouri; (2) to review and evaluate the counselor's academic preparation; and (3) to obtain his opinion concerning the duties he believes a counselor should perform.

In January, 1954, questionnaires were sent to the 264 certified counselors in the State of Missouri as a means of obtaining information for the study. Two hundred ten counselors responded to the questionnaire. In addition, forty counselors were interviewed in order to enrich the study and to serve as a basis for evaluating the reliability and validity of the questionnaire.

The typical counselor serves as a classroom teacher two periods each day, most frequently as an instructor in the Social Studies. He spends three periods each day in counseling work, is responsible for 508 students, conducts eighty student interviews each month for an average of twenty-six minutes each.

Of the time devoted to pupil personnel and guidance

services, approximately 55 per cent is spent in counseling, 13 per cent in testing, 12 per cent in clerical work, 9 per cent in test scoring, and 11 per cent divided between checking absentees and tardiness, in-service training, remedial instruction, and such duties as organizing college days, career days, and conducting surveys covering student problems.

In general, the duties performed by counselors who held Professional Certificates, Teacher-Counselor Certificates, and Temporary Certificates were similar.

The duties of the school counselor vary with the type of school situation in which he works. The following general conclusions, however, were drawn from the study: (1) The counseling load is too heavy; (2) Very few schools have adequate physical facilities for counseling students; (3) Very little direction or assistance is given to counselors by those responsible for their activities; (4) Duplication of counseling work is not a major problem; (5) Counselors function best when they know their professional strengths and weaknesses; (6) There is an indication of a positive relationship between the levels of training of counselors and the extent to which they participate in professional organizations; (7) The counselor has an excellent opportunity to strengthen the ties between the school and the community; (8) Counselors should play a greater role in the curriculum development program of the school; (9) More intern and practicum courses are needed to enable the counselor to develop creatively and to integrate his academic knowledge with functional courses; (10) More training is needed in sociology to prepare the counselor to understand better the subcultures of the community; (11) Since some professional courses are more meaningful after the counselor has had work experience summer courses and work-shops should be set up to meet this need; (12) A course in group guidance should be required for counselor certification; (13) More training is desired in sex education; (14) The School or Department of Education should facilitate the use of other departments or schools on the campus in the preparation of counselors; and (15) Administrators should take certain basic guidance courses, and they should be included in the in-service training program in order that they may understand better the role of the counselor.

204 pages. $2.55. MicA 55-996

AN ANALYSIS OF EARLY ALGEBRA TEXTBOOKS USED IN THE AMERICAN SECONDARY SCHOOLS BEFORE 1900

(Publication No. 11,592)

Angie Turner King, Ph. D.
University of Pittsburgh, 1955

The purpose of this study is to analyze the content of algebra textbooks used in the American secondary schools before 1900. The analysis shows (1) the aims of the authors, (2) the evolution of subject matter, (3) the problem content, and (4) the teaching and learning aids. The materials, in general, are organized under topics.

The method of procedure was as follows: (1) the subject matter of the textbooks was analyzed according to determined categories incorporated in a checklist; (2) broad topics were derived to facilitate treatment; (3) the content of these topics and their development were determined for each decade on the basis of the number of pages devoted to each topic; (4) the total number of pages devoted to problems, both verbal and nonverbal, and to extrinsic content was tabulated; (5) the aims of the authors were obtained from an analysis of the prefaces and introductions of the textbooks; and (6) comparisons and tendencies disclosed by these tabulations served as a basis for the interpretation of the findings in terms of modern standards for textbooks in secondary-school algebra.

It was found that the earliest algebra textbooks of the nineteenth century were either written by or reflected the influence of the English and French writers.

The dominant aim of the authors of old algebra textbooks was mental discipline achieved by exercises requiring memorization and application of rules. There was a trend toward making an easy transition from arithmetic to algebra.

The study revealed an increase in the fundamental operations. Even though equations received the greatest emphasis of any division of subject matter, there was an overall decline in the percentage of equations.

The subject matter of factors, factoring and multiples, algebraic fractions, the binomial theorem, permutations and combinations, and probability and chance showed the greatest increase in emphasis during two or more decades of the latter half of the nineteenth century. Proportion and progression remained relatively constant. Roots and radicals and the theory of equations declined during the latter half of the nineteenth century.
Logarithms and applications received greatest emphasis during the decades 1830-1839 and 1860-1869. The greatest emphasis in series in general was during the decade 1890-1899.

The subject matter of imaginaries, inequalities, parentheses as a separate topic, graphs, geometry, and differentiation received only limited emphasis and inclusion by the authors of early algebra textbooks.

The average number of nonverbal problems far exceeded those for verbal problems.

At least 12 different teaching and learning aids were employed by the authors. Tables of contents, prefaces, introductions, answers, tables, and notes were the chief aids.

The general conclusions are as follows:

1. Some of the aims of the authors of old algebra textbooks are included in the present aims of algebraic instruction. The dominant aim was mental discipline. Other aims included were college preparation and practical application.

2. The analytic method and the logical development of subject matter, which were characteristic of old algebra texts, are not in agreement with present standards and practices.
3. Many of the situations involved in the verbal problems, especially during the early nineteenth century, do not meet the present standards of concrete problems. There was not a radical change in the subject matter of nonverbal problems. Complex formal exercises persisted.
4. Both the subject matter and method of English and French authors were responsible for the highly theoretical and advanced materials included in the American editions.
5. The inclusion of teaching and learning aids indicates that authors were concerned about the pedagogical principles of learning as well as with the self-reliance of pupils at a time when well trained teachers were not plentiful. 222 pages. $2.78. MicA 55-997

THE CONTROL OF OCCUPATIONAL ENTRY AND PRACTICE BY STATE EXAMINING BOARDS, COMMISSIONS, AND DEPARTMENTS

(Publication No. 11,594)

Frederick Carl Krause, Jr., Ed. D.
University of Pittsburgh, 1955

This study is a survey of the restrictions and limitations placed upon occupational entry and practice which are imposed and exercised by state examining boards, commissions, and departments of the 16 states of northeastern United States.

Certain elements of the problem are related primarily to the licensing bodies of the states. These are:

1. A determination of the number of licensing authorities.
2. A survey of the statutes laid down by legislative enactment which define the nature of the licensing authorities with regard to the composition of the boards, the relationship of the members of the licensing authorities to the members of the various crafts, the types of qualifications required for membership on the boards, the manner in which the board members are appointed, and the powers of the various licensing agencies.

Other elements of the problem bear a direct relationship to the occupations licensed by the states. These are:

1. A determination of the number and kinds of occupations licensed by the particular authorities within the states.
2. A survey of the qualifications which serve as barriers to the individual in the selection of the vocation of his choice and which are stipulated by legislative enactments and rulings of state authorities for the issuance of professional and trade licenses.

The research method utilized in this study is a documentary analysis of the (1) various state legislative enactments defining and authorizing the creation of licensing boards, (2) published rules and regulations of the licensing agencies, (3) materials published by the boards for the use of prospective licentiates, and (4) publications of trade and professional associations relative to licensing procedures. Frequency and percentage distribution tables are used in summarizing the data.

The data show that the state regulation of occupational activity within the northeastern United States is administered by at least 314 agencies which may be grouped into 53 kinds of boards classified according to the major occupation licensed by each. These 314 agencies exercise licensing control over 96 kinds of occupations. The regulatory powers of the examining boards are those of examination, suspension and revocation of license, approval and suspension of schools, regulation of business, appointment of staff, and the enforcement of statutes. The principal types of qualifications necessary for licensure are those of education, apprenticeship, experience, examination, citizenship, state residency, mimimum age, character, knowledge of laws, personal interview, and the filing of a bond.

This study of the control of occupational entry and practice presents clearly defined educational implications affecting vocational guidance theory and practice. Because of the increasing control of occupational activity, the vocational counselor may make definite contributions by assisting students in understanding the purpose of state occupational controls and by developing sympathetic attitudes toward the state regulation of occupational entry and practice. Further implications are that the secondary school must provide experts who are aware of the nature and the scope of the state control of occupational activity, who are familiar with the qualifications required for entrance and practice in these licensed occupations, who have a wide understanding of the complexity of modern civilization and technological advances, who possess the necessary training and skills to assess human aptitudes, abilities, and limitations, and who are skilled in sound counseling procedures relative to vocational advisement. The contribution of this thesis is its exposition of the extent and ramifications of state occupational regulation which should be known to school guidance workers.

220 pages. $2.75. MicA 55-998

A CONSIDERATION OF THOSE CRITICISMS OR ATTACKS DESIGNED TO HARM PUBLIC EDUCATION AND SOME SUGGESTED MEASURES TO HELP PREVENT THEIR OCCURRENCE IN MARYLAND

(Publication No. 11,889)

William Dean Manifold, Ed. D.
University of Maryland, 1954

Supervisor: Professor Clarence A. Newell

The purpose of this study is to determine some measures which can be suggested to help prevent the occurrence of criticisms or attacks designed to harm public education in Maryland. Criticisms or attacks designed to harm are those which utilize techniques identified by Virgil Rogers as characteristic of dishonest critic groups. Some examples of these characteristics are: 1) Tends to work under cover; 2) attracts emotionally unstable people; 3) accepts rabble rousing techniques; 4) permits only one side of an issue to be presented; 5) attacks personalities; and 6) other similar characteristics.

School officials in nineteen Maryland counties cooperated in the study through personal interviews which utilized a questionnaire. School officials were regarded as the best sources of information since they are in the best position to know the measures in current practice which have the greatest chance for successful application in real situations.

The study includes an overview of the criticisms now being directed toward public education by way of preparation for the interviews. This overview is developed in two parts. The first part considers some conditions in our present culture which could be conducive to harmful criticism of public education. This consideration is accomplished through brief interpretations of (1) the emotional climate of the times; (2) the financial support of education; and, (3) the leadership of educators. The second part considers groups and individuals who express criticism designed to harm public education. This consideration is accomplished by the presentation of (1) groups and individuals identified as attackers; (2) their operational techniques as reported in three locales where harmful criticism has occurred; and, (3) selected statements from the writings of individuals who express strong biases against public education. This information tended to show a need for the study and provided a frame of reference within which the contributors could suggest the most applicable measures.

The questionnaire results indicate that Maryland public school systems have experienced few criticisms or attacks designed to harm. The results also indicate that Maryland school officials are aware of their existence and use numerous measures by which they are attempting to prevent their occurrence in Maryland.

The organization of all the measures submitted resulted in twenty-five groupings of measures. The measures as a whole represent efforts on the part of Maryland educators to communicate with the people so that they might be informed about and involved in the public education venture. The widespread use of such measures could be indicative that Maryland school officials consider the public schools as being the people's schools and their conduct to be subject to the will of the people.

General recommendations growing out of the data indicate that school officials should work toward the prevention of criticisms or attacks designed to harm by (1) further developing school-community relations; (2) exploring the possibility of broadened citizen participation; (3) engaging in continuous curriculum development programs; (4) studying all phases of the educational system to increase overall efficiency; (5) working together to provide an educational program capable of producing products of high quality; and (6) formulating plans to the end that lay and professional personnel can become more sensitive to the nature of attacks and, consequently, be better prepared to prevent or meet them.

188 pages. $2.35. MicA 55-999

A FOLLOW-UP STUDY OF SELECTED REGISTRANTS IN THE BUREAU OF EDUCATIONAL PLACEMENT AT INDIANA UNIVERSITY WITH SPECIAL EMPHASIS DIRECTED TOWARD THE NON-TEACHING GROUP

(Publication No. 11,201)

Stephen Blake McIntosh, Ed. D.
Indiana University, 1954

In view of the current teacher shortage, this study was an attempt to determine the present occupational status, academic background, family data, and interest in current or future educational employment of those persons graduated with bachelor's degrees from Indiana University who had registered with the Bureau of Educational Placement at the University some time between 1946 and 1952.

A mailing list was compiled from records in the Bureau and included the names and addresses of 2,350 registrants.

A pilot study involved sending sample questionnaires to 100 registrants selected at random. Following slight modifications, questionnaires were sent to the remaining 2,250 members of the registrant population. A second and a third follow-up questionnaire, together with a covering letter, were sent when necessary.

The returned questionnaires were divided into two categories: one from registrants who were currently teaching; and one from registrants who were not engaged as teachers nor interested in future teaching. A random sample of 10 per cent was selected from each group: 80 from the teaching group of 800, and 50 from the non-teaching group of 500. There were 1700 completed questionnaires which represented a 76 per cent return.

Statistical treatment of data involved the use of the Critical Ratio Test for comparing psychological test scores of the two groups, and the Chi Square Test for comparing goodness of fit between references, schools within Indiana University, and bachelor degrees. Differences were considered significant at the five per cent level.

The findings indicated that a large number of the individuals who prepared to teach either never entered the educational field or withdrew from it within several years. The percentage of non-teachers and teachers was nearly equal; however most non-teachers were women with family responsibilities.

Reasons for current lack of interest in educational work, as stated by the men in the non-teaching group, were varied; however lack of a sufficient living wage ranked high.

There was a small significant difference in favor of the non-teaching group in ability to perform on the A. C. E. Test. For the C^2 Test, the difference between the two groups was negligible.

The Chi Square comparison indicated no statistically significant differences between the groups regarding kinds of bachelor degrees, schools within the University or confidential references.

There were more members of both groups holding B. S. and M. S. degrees than there were registrants holding B. A. or B. M. degrees. The non-teachers had more children than the teachers. There was a higher percentage of single men in the non-teaching group and a higher percentage of single women in the teaching group.

The highest number of degrees was from the School of Education, arts and science degrees rated second.

The non-teachers received a higher percentage of superior confidential ratings than did the teaching group.

Conclusions

There is a potential of 410 registrants not currently teaching, but interested in entering the field.

Many women in the non-teaching group expressed a desire to teach when their children reached school age.

Many men in the non-teaching group indicated a continuing lack of interest in the field until such time as salaries were substantially increased.

Kinds of bachelors degrees held by the registrants had no bearing upon their subsequent entry or non-entry into the teaching profession.

The fact that registrants received their degrees from the School of Education rather than from some other school at Indiana University, had little bearing upon their subsequent employment status.

The non-teaching group possessed a slightly higher intelligence level than the teaching group.

The student-teacher ratings in the registrant's confidential references, might not be meaningful in view of the unusually large proportion of superior and above-average references, and the absence of poor references.

106 pages. $1.33. MicA 55-1000

ATTITUDE CHANGES AMONG FIRST YEAR COLLEGE MEN LIVING IN FRATERNITIES AND RESIDENCE HALLS

(Publication No. 11,537)

Darold Lee Shutt, Ed. D.
University of Illinois, 1955

The major purpose of this work was to study changes in attitude among residents of college fraternities and residence halls. Both living group systems have stated objectives which reveal that attitude change is a major concern of those planning the residence hall and fraternity programs. The extent to which the living groups were able to affect attitude change among their members constituted an evaluation of the influences of the groups upon members. A survey of the literature indicated that few definitive studies have been made in the area of attitude change among college men and no investigation could be found in which a comparison had been made of attitude changes among living group members.

The subjects used in the study were from a population of first semester freshman men. An analysis of the sample showed them to be a representative group of the first semester freshman men of the university. Sub-groups were established within the sample for each of the instruments used in measuring attitude change. Individuals were assigned to the sub-groups on the basis of scores obtained from a pre-test. Fifty pledges and forty-nine dormitory students could be readily classified in one or more of the sub-groups.

Data for the study was collected by means of a pre-test and a post-test. These tests were spaced by twenty weeks, the first being administered the fourth week of the first semester and the second being administered the twelfth week of the second semester. The attitudes held by the subjects were assessed on the fall testing with the aid of three instruments: Woodruff's "A Study of Choices," the Minnesota Personality Scale, and a Modified Thematic Apperception Test. The same three instruments were used for the spring testing. Scores made by each subject on the fall test were compared with his scores on the spring test. The mean scores of each sub-group were compared.

Data was analyzed separately for each of the instruments. The attitude changes were tested for significance through the utilization of chi square for the Woodruff Test and the t-test for correlated variables for the Minnesota Personality Scale and the Modified Thematic Apperception test. The areas studied were attitudes involving: morale, social life, family relations, and economic conservatism. Also included was an examination of changes in the subjects' emotionality, acceptance of adults, acceptance of peers, and acceptance of self.

Within the limits of the study certain observations and conclusions seem to be justified by the evidence. The pressures which influence a pledge's choice of a living group change during the course of his first year in college. Pledges' changes in

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group selection were significant at the one per cent level of confidence. Fraternity and residence hall men showed an increase in scores on family relations which was significant at the five per cent level. Both pledges and residence hall students had less conservative attitudes by the time of the spring testing. Their attitude changes with reference to economic conservatism were significant at the five per cent level of confidence.

Although changes were observed in morale, social life, emotionality, acceptance of adults, acceptance of peers, and acceptance of self, the extent of change did not reach the five per cent level of confidence.

91 pages. $1.14. MicA 55-1001

THE TEACHING VALUES OF THE PREPARED BIOLOGY DRAWING VERSUS THE ORIGINAL DETAILED LABORATORY DRAWING

(Publication No. 11,881)

Russell S. Wallin, Ed. D.
Syracuse University, 1954

Purpose

To prove or disprove the following hypothesis:

Students labeling and using commercially printed drawings will equal or surpass the achievement gain in factual knowledge made by students completing and labeling detailed free-hand drawings.

Subjects

This investigation was conducted at the State University Teachers College at Brockport, New York, utilizing the data secured from 195 sophomore students enrolled in the one year course entitled "General Biology" during the years 1948 - 1949 and 1949 - 1950.

Method

In order to carry out this study it was necessary to establish a uniformity of course content material for all sections taking general biology. The first step in the process of evaluation was to set up objectives for the course.

The next step in the procedure was the formation of a course outline. The purpose of the outline was twofold:

1. To select subject matter that would prove to be most effective in achieving the objectives.
2. To bring about course uniformity in content material for all students and instructors involved in this study.

The first portion of the study utilized two sections in general biology and they were taught by one instructor. The period of instruction covered a school year of nine months from September, 1948, through May, 1949. One section used commercially printed drawings while the other section used detailed free-hand laboratory drawings.

The second portion of the study utilized eight sections in general biology and they were taught by four instructors. The period of instruction covered nine months from September, 1949, through May, 1950. Four sections used commercially printed drawings and four sections used detailed free-hand drawings in the laboratory.

Instruments used:

1. Otis quick-scoring intelligence test.
2. Pre-test (Cooperative College Biology Test)
3. Post-test (Cooperative College Biology Test)
4. Commercially printed drawings.
5. Detailed free-hand drawings.

All sections were compared statistically on the basis of the following data.

1. Intelligence test scores.
2. Pre-test scores
3. Post-test scores
4. Raw-score gain scores (the difference between pre-test and post-test scores).

The statistics computed from the above data were:

1. Mean
2. Standard deviation
3. Standard error of mean
4. Standard error of difference between means.
5. Actual difference between means.
6. Critical ratio.

Conclusion

The data collected by this investigation makes it possible to state that the hypothesis has been proved to be true. The evidence presented in this study definitely proved that students who labeled and used commercially printed drawings equalled or surpassed the achievement gain in factual knowledge made by students who completed and labeled detailed free-hand drawings. It is also possible to state that the commercially printed drawings saved time in the laboratory.

The proof of the hypothesis holds true and is contingent upon the control of the following variables:

1. The factor of intelligence in the experimental and control groups.
2. The course uniformity of the experimental and control groups.
3. The influence of the instructor and his methods of teaching in the experimental and control groups.
4. The validity of the measuring instrument in determining the amount of achievement gain in factual knowledge made by the experimental and control groups.
5. The uniformity in the amount of material covered in the laboratory by the experimental and control groups. The "time saved" in the laboratory by the experimental groups, using prepared drawings, was not used to cover additional material.

157 pages. $1.96. MicA 55-1002

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

EDUCATION, ADMINISTRATION

RULES, POLICIES, AND PRACTICES OF SCHOOL BOARDS IN RELATION TO TEACHER DISABILITIES

(Publication No. 11,196)

Charles Elmore Aebersold, Ed. D.
Indiana University, 1954

The major purpose of this study was to gather data from school boards to determine the nature and the scope of the rules, policies, and practices of these boards in relation to teacher disabilities. This was done to study how the local policies, regulations, and practices compared with those of the state and to determine how, by whom, and to what extent disabilities were established.

This study was confined to the public schools in the 11 southern states accredited by the Southern Association of Colleges and Secondary Schools, which had a civil population of 2,500 or more based on the 1950 census. There were 974 such schools.

Certain criteria were arbitrarily established after personal interviews with experts in the fields of education, teacher welfare, and handicapped and disabled persons. Upon these criteria and upon literature closely related to this topic, a questionnaire consisting mainly of checklist questions was developed under supervision. The responses to this questionnaire, completed by the superintendent of schools, served as the chief source of data. There were 606 (representing 62 per cent of the schools).

The study suggests the following conclusions which are tentatively offered with the hope that they may be of some value:

1. Most superintendents are willing to cooperate with any sound process which will assist them in securing information upon which they may further improve their own school systems.
2. Certain physical and mental conditions should bar one from the teaching profession.
3. Handicapped persons are employable unless their handicaps hinder effective school duties.
4. Sick leave days and accumulative sick leave days are provided but in many instances not to a degree considered adequate.
5. School boards do not place enough emphasis on periodic physical examinations and complete records of health, injuries, and accidents of teachers.
6. No fair, adequate, or uniform reciprocity exists among the 11 states in regard to out-of-state teaching.
7. Coverage by workmen's compensation benefits would improve the status of temporary disability provisions for teachers.
8. A uniform method of determining disability is greatly needed, and criteria for judging disability are greatly lacking.
9. The length of prior-service and the waiting period before benefits are received if disability is incurred is too long in most instances.
10. More uniformity in rules, policies, and practices of school boards in relation to teacher disabilities needs to be established and practiced throughout the 11 states.

The following brief recommendations are made relative to the improvement of current rules, policies, and practices of school boards in relation to teacher disabilities. These recommendations are based upon the findings of the study and upon the writer's own experience and opinion. It is recommended:

1. That the school boards examine more carefully the disability provisions available to their teachers to see what can be done to improve or alter these provisions.
2. That the school boards examine the criteria used in the study as a guide for improving the disability provisions available to teachers in their own jurisdiction.
3. That the school boards examine the feasibility of accepting the criteria used as a basis of standardizing their rules, policies, and practices in relation to teacher disabilities.

159 pages. $1.99. Mic 55-96

THE DEVELOPMENT OF THE COUNTY SUPERINTENDENCY IN PENNSYLVANIA

(Publication No. 11,584)

Gwilym David Davies, Ed. D.
University of Pittsburgh, 1955

This is a study of the origin and development of the office of county superintendent of schools in Pennsylvania. Educational problems can be examined more sympathetically and with less bias when they are viewed in the light of their origin and growth. A knowledge of the historical development of the county superintendency in Pennsylvania, therefore, should be a necessary preliminary to a complete understanding of the role of the county superintendency in the administration of public education in the Commonwealth. Accordingly this study was planned as a contribution to the project of the American Association of School Administrators and W. K. Kellogg Foundation to improve the professional status of school administrators.

This study is concerned with the office of county superintendent of schools only as it evolved in Pennsylvania. The problem, as developed, has four elements dealing with (1) the origin of the office of county superintendent of schools; (2) the evolution of the qualifications for the office of county superintendent of schools; (3) the evolution of the duties of the county superintendent of schools; and (4) the reactions of county superintendents of schools to the challenge of educational leadership.

The historical-documentary method of research was employed. Data were collected and recorded on 4 by 6 cards with the longer passages on 8-1/2 by 11 paper. Complete information for documentation was included with each passage. The notes were

filed under topics suggested by the elements of the problem, and later, when the organization of the dissertation had been refined, under headings of the main divisions of the research.

Critical analysis and interpretation of the data were followed by further refinement of the organization of the problem and, finally, composition. It seemed best to use a topic organization and to follow chronological order within the topics.

The results indicate that the following major conclusions are warranted:

1. The office of county superintendent of schools in Pennsylvania was established to overcome inadequacies in supervision and administration at the local level which no longer exist.

2. Expediency dictated adoption of county boundaries for the establishment of intermediate administrative units. This decision and the method of electing the county superintendent gave to the office a political status that has been an obstacle to its full development.

3. Early antagonism toward the county superintendency was a manifestation of provincial thinking which regarded education as the sacred precinct of the people and caused local residents to regard with suspicion anything or anybody representative of state school administration.

4. The statutory powers and duties of the county superintendent set forth in the Law of 1854 met the developing needs of the office for many years. Educational leadership became the principal non-statutory duty of the county superintendent.

5. The transition of the county superintendency to a special service agency was under way before this concept of the intermediate unit was clearly defined in educational thinking. Potential opportunities for a new kind of educational leadership are abundant in the new concept of the intermediate unit, but few county superintendents have had the vision to move boldly in this direction.

The general conclusion is that the office of county superintendent in Pennsylvania should be either modified considerably or discontinued. Modification would involve combining some counties into larger intermediate units, provisions for new qualifications and training for assistant superintendents to prepare them to serve as specialists, and possibly a new method of appointment for intermediate superintendents. Abolition of the county superintendency would require administration of essential services through a new unit. Study and careful planning would be a necessary preliminary to such action, but the proposal presents the possibility of an intermediate unit unhampered by tradition and free from political influences. 190 pages. $2.38. MicA 55-1003

AN INVESTIGATION OF THE RELATIONSHIP OF SOCIAL CHARACTERISTICS TO RESPONSES FROM SELECTED MICHIGAN HIGH SCHOOL COUNSELORS

(Publication No. 9942)

Allan Charles Erickson, Ed. D.
Michigan State College, 1954

The counseling profession has grown and developed in response to the needs and demands of our modern complex society. As the profession grew, so did the range of problems with which it dealt. Today the counselor deals with a wide variety of personal and social problems.

In the early growth of the profession rapid shifts in personnel were made. There were no standards for selection and training of these early counselors. Today the profession is moving towards the establishment of training standards and a process of certification.

An investigation of the literature reveals that some investigation of the social characteristics of counselors has been made. However, there is little research or evidence to show the relationship of these characteristics to performance. If standards are to be established there is a need to know the relationship of characteristics to performance.

The problem of this study was (1) to discover the social characteristics of counselors, (2) to obtain counselor's responses to a series of test cases developed for this study, and (3) to determine the degree of relationship between these social characteristics and the response typology of counselors.

The method used was a mailed questionnaire that was designed to discover the social characteristics of counselors and to get responses to the alternatives contained in the test cases.

The counselors were to respond to the test cases by agree, disagree, or undecided. Their responses were then subject to a Chi-Square analysis to discover the degree of association between the selected social characteristics and their response typology. The level of significance established for this study was .05 or less.

The social characteristics selected for contingency analysis were sex, age, education, and status concepts. The latter refers to the counselors view of his social status in relation to that of his parents. These were selected because preliminary analysis indicated their possible significance.

Several hypotheses were developed for the purposes of this study. They were (1) Since counselors are a relatively homogeneous group with respect to education and occupation, they can be expected to react in similar ways to the same case data; (2) Counselors will tend to sublimate their own motivations and personal biases in the counseling situation; (3) Counselors, in a conflict of the individual and institutional equilibrium, will tend to support the individual; and (4) The way in which a counselor views his social status is related to the way in which he reacts to case data.

The sample selected for the study was high school counselors who were members of the Michigan Counselors Association. They were selected because they were on record as being in favor of certification and had active committee working on the problem at the time of the study.

The findings indicate that counselors in Michigan come from families that enjoy a fairly secure economic position. The counselor comes mainly from families where the father was either a farmer, skilled or semi-skilled worker, or in a profession.

The respondents are a stable group occupationally, most of them having been in the field five years or more. The greater majority have at least a masters degree. That they are educationally oriented is demonstrated by their responses to the test cases and the fact that they are, in most cases, the most educated sibling in the family.

There is evidence of upward occupational mobility when their education and occupation is compared with that of their father.

Contingency analysis of the response typology in the test cases reveals several significant findings. The counselors in the study, as a rule, do not react in a similar way to the same case data. Further, there are significant differences in response on the basis of the respondent's sex.

The evidence does indicate that counselors do inject their motivations and biases into the case situation. Also, they tend to support higher education regardless of the other values which were present in the test cases.

Perhaps the most significant findings is that counselors view their social status differently, and that difference is significantly related to responses in most of the test cases.

147 pages. $1.84. MicA 55-1004

A PLAN FOR THE IMPROVEMENT OF THE EDUCATIONAL PROGRAM AND THE SUPPORTING FACILITIES OF THE WESTERN PENNSYLVANIA SCHOOL FOR BLIND CHILDREN

(Publication No. 11,593)

Alton Gilmore Kloss, Ed. D.
University of Pittsburgh, 1955

This study presents a plan for the improvement of the educational program and the supporting facilities of the Western Pennsylvania School for Blind Children. Such a study is necessary because of the dearth of studies previously done in the field of the visually handicapped, and because the increasing incidence of blindness in infants has intensified the problem of their education in residential schools. The study endeavors to ascertain the aims, objectives, and philosophy of education which will contribute maximally to the development of blind children; to evaluate the current educational program of the Western Pennsylvania School for Blind Children in the light of the aims, objectives, and philosophy; and to make recommendations based upon these findings which will help the school to achieve sound educational goals.

The study presents a brief history of organized education for the blind, from its beginnings in Europe, through its introduction into America, and emphasizes the educational and physical development of the Western Pennsylvania School for Blind Children.

A thorough investigation of the literature has been made to determine the aims, objectives, and philosophy of education for both sighted and blind children, based upon statements of authorities in these fields of education. This research indicates that the philosophy of education for the blind is identical with that of education for the sighted. It is the tools of education which differ in that they must be adapted to the use of the visually handicapped.

On the basis of ideas expressed in the writings of these authorities, the superintendent and key staff members of the Western Pennsylvania School for Blind Children have developed a philosophy of education and have subscribed to a statement of specific educational aims and objectives for the school. Since there are no essential differences between the aims and objectives of education of blind and sighted children, the Western Pennsylvania School for Blind Children has adopted as its specific goals the four aspects of educational purposes set forth in the 1938 report of the Educational Policies Commission, namely, self-realization, human relationship, economic efficiency, and civic responsibility.

The current status of key elements of the educational program and supporting facilities is described, and evaluations and recommendations are made to modify the curriculum, as well as to strengthen the school's program in the areas of teaching staff, buildings, equipment, finance, and public relations.

It is recommended that the curriculum be strengthened by the inclusion of additional speech training, drill in spelling and mental arithmetic, addition of sociology and problems of democracy, expansion of the homemaking and commercial curricula, and training in the use of power sewing equipment in the vocational classes.

It is recommended that the teaching staff meet educational standards comparable to those of public schools, that their salaries be adequate to maintain these standards, and that the University of Pittsburgh be encouraged to include in its special education section classes to prepare teachers of blind children.

The nursery and kindergarten building must be made adequate to meet the needs of an increasing number of pre-school blind children.

Purchase of certain equipment is recommended over a long-term plan.

A plan is set up in detail to enable the school to maintain and increase its income and to control its expenditures.

The existing public relations department has proved so effective that no modification is necessary.

It is hoped that the study will serve as a stimulus and blueprint for other residential schools to reconsider their purposes and to modify their practices

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so that they may better serve the educational needs of their blind children.

The study also attempts to pose further questions for research in the field of education of the blind. This research is necessary because of the rising incidence of blindness in young children, all of whom should be prepared to enter a sighted world as well-adjusted, productive citizens.

152 pages. $1.90. MicA 55-1005

ORGANIZATION AND ADMINISTRATION OF ELEMENTARY TEACHER EDUCATION IN THE PHILIPPINES

(Publication No. 11,165)

Miguela Macalinao-Solis, Ed. D.
Stanford University, 1955

This study explored and identified the basic considerations in the organization and administration of desirable elementary teacher-education programs geared to the nation-wide movement for socio-economic prosperity and security in the Philippines. The project emphasized possible solutions to problems now being encountered by the regional teachers colleges of the Philippine Government. The results will serve as a guide in improving both public and private teacher-education institutions.

Philippines socio-economic data were analyzed for goals to be realized through the community schools. Such information was contained in official census statistics, surveys, reports of governmental and private agencies, investigations by Filipino and American experts, reports of UN agencies, and literature by Filipino and foreign observers.

Findings of the Study

The major functions of the community schools, determined by the country's vast resources, together with Philippines needs and problems are to: select and organize teaching-learning activities, experiences, and situations from the present status and growth potentials of resources, needs and problems; maintain and extend desirable aspects of cultural heritage; understand and educate all ages of learners as individuals and group members; administer schools and community as interdependent in a democratic system; aid personal-professional growth of school personnel; develop appraisals through evidence of changes in learners, home living, community conditions and agency services in adequately meeting community needs, and utilizing resources.

The resultant teacher's roles are: organizer of teaching-learning experiences based on community conditions and resource potentials; transmitter and extender of cultural heritage; helper, guide, and counselor; liaison between school and community; congenial school-community member; an active member of the profession. If the above functions are properly executed, the community schools will foster maximum individual growth as well as improvement and enrichment of community living.

The three major phases of teacher education required to enable adequate preparation for the future teacher to live fully as an educated person and to perform successfully as a teacher are: General Education – growth in citizenship, knowledge, skills, abilities, and attitudes; Educational Foundations – fundamental principles, theories, and practices underlying the WHAT, HOW, WHEN, and WHY of education; Professional Education – major principles, theories and practices characteristic of elementary teaching. These phases are closely interdependent and interrelated in producing competences expected of teachers.

Since each region has characteristics peculiar to itself, no two colleges can offer identical programs. The proposed program, therefore, should serve primarily as a guide.

A desirable teacher-education institution: provides understanding of its own service area; cooperates with community agencies; develops its on-campus laboratory school as a dynamic research center; maintains relationships with community schools for students to live and learn realities in teaching; assumes professional leadership; and devotes total resources to the development of teaching competences.

Basic policies in administering such programs require: adequate student and faculty welfare provisions; desirable criteria for faculty selection; continuous evaluation by staff and laymen of current national and regional problems; necessary personnel and resources to develop these programs; systematic recruitment, selection, counseling, placement and follow-up of students; active cooperation in national accreditation and certification; line-staff administrative organization; active involvement in teachers' associations; active cooperation regarding the proposed Division of Teacher Education.

Results of this study leave much work both for the Central Office of Teacher Education and regional colleges. To prepare and maintain competent teachers some researches are urgently needed: socio-economic studies of each region; improvement of educational techniques; participation in National Economic Council five-year plans; education of Filipinos for the power-machine age; pupils' participation in community services; avoidance of duplication of projects and better coordination between community schools and other agencies in fostering the national movement for continuous socio-economic prosperity and security.

428 pages. $5.35. MicA 55-1006

A STUDY OF PUPIL HUMAN RELATIONS WITHIN THE SCHOOL AS INFLUENCED BY THE PRINCIPAL'S PATTERN OF BEHAVIOR

(Publication No. 11,477)

Honor E. Maynard, Ed. D.
The University of Florida, 1955

The study, designed as a part of the research project in educational administration being conducted by the University of Florida under the sponsorship of the W. K. Kellogg Foundation, had for its purpose the investigation of relationships between the principals' ways of working and pupil human relations within the school.

The sample consisted of 1910 pupils of the sixth grade, 1514 pupils of the ninth grade, and 1495 pupils of the eleventh grade, making a total of 4919 pupils participating in the study. This sample was the entire sixth, ninth, and eleventh grades of forty schools of Hillsborough County, Florida. Each of the schools was classified as democratic or authoritarian according to the principal's scores on Florida-Kellogg Democratic and Authoritarian scales, which indicated the relatively democratic or relatively authoritarian ways of working of principals.

The Ohio Social Acceptance Scale and Battle's Student Attitude Scale were administered to each class by means of group testing programs in each school. Raw scores were grouped according to sex of the pupils, school grades, and democratic or authoritarian classification of schools. Means of the democratic groups were compared to means of the authoritarian groups by regular statistical procedures. Correlation methods were used to determine relationships between pairs of variables including Battle's general attitude scores, various principal scores on Florida-Kellogg scales, income level of the school-community, occupational level of parents of pupils participating in the research, and size of the school. Democratic and authoritarian elementary schools, matched according to occupational level, were compared on the basis of mean scores of general pupil attitude.

Of sixty-eight critical ratios testing the significance of the difference between the means of democratic and authoritarian groups, thirty were significantly in favor of the democratic schools. In only nine of the sixty-eight did the comparisons of the authoritarian groups exceed the means of the democratic groups, and in none of these nine cases was the difference significant.

A larger number of statistically significant differences were found between elementary groups than between junior high or senior high school groups. Fewer significant differences were found for junior high groups than for groups of the senior high schools.

Pupil attitudes are significantly related to principals' scores on Florida-Kellogg scales, to occupational level of parents, to income level of parents, and to size of the school. The order of influence of these variables according to the magnitude of the coefficients of correlation is occupational level, income level, principal democratic ways of working, size of school, and principal "best practice" scores. Authoritarian ways of working when correlated with pupil attitudes yielded a negative coefficient.

Attitudes and feelings of pupils of democratic schools were proved different from attitudes and feelings of pupils of authoritarian schools, the democratic pupils expressing the more favorable attitude toward their school.

Principal authoritarian ways of working influence negatively the attitudes and feelings of pupils.

The order of positive influence on pupil attitudes appears to be occupational level of the parents of pupils expressing the attitude, income level of the school-community, principal democratic ways of working, and size of school.

All other things being equal, principal behavior is an important factor in pupil attitude and feelings, especially in the elementary schools.

177 pages. $2.21. MicA 55-1007

A SURVEY OF THE OPINIONS OF PITTSBURGH SENIOR HIGH SCHOOL TEACHERS ON THE AIMS AND OBJECTIVES OF SECONDARY EDUCATION

(Publication No. 11,598)

Earl Milton McWilliams, Ed. D.
University of Pittsburgh, 1955

This research is a survey of the opinions of senior high school teachers on the aims and objectives of secondary education. Teachers in a large city system responded anonymously to an opinion questionnaire based on concepts found in books and articles by ten national educational organizations interested in the secondary school. The questionnaire was constructed in accordance with standards derived from a study of the extensive professional literature on opinion polling.

Data yielded by the questionnaire returns were studied to discover the nature of teacher opinion and the implications of that body of opinion for administrative planning. Since the ten source authorities represented divergent points of view on many issues dealt within the questionnaire, there was no possibility of using statistical methods to evaluate teacher responses against a "correct" set of answers. Therefore, this study is confined primarily to a demonstration of the effectiveness of opinion polling in ascertaining teacher opinion, and it ventures in only a few areas to compare the questionnaire results with existing conditions or a consensus of the authorities. Consistency of responses to related items indicates that the questionnaire has internal validity.

Emerging from the study of the responses, a picture of the opinion pattern of these secondary school teachers shows these characteristics to be evident:

1. An adequate understanding of the nature of adolescent youth is apparent.
2. Teachers are satisfied with the present traditional high school curriculum, desiring only minor alterations therein.
3. There is a strong belief that the child should fit the school, not the opposite. Youth who do not enter or can not finish high school are not regarded as the responsibility of the school.
4. School is regarded primarily as a place for mastery of subject matter.
5. The solution to problems of discipline is held to be a return to authoritarianism and not a revised program that more adequately meets the needs of youth.
6. Teachers agree easily with ideal aims and objectives when they are stated as broad principles, but retreat when confronted with specific applications of the principles which imply changes in routine or threats to the security of the status quo.

Conclusions of the study serve as indications of the nature of the need for in-service training programs for these teachers. The results show teacher opinion to be at variance with administrative policy in many areas. Only through a careful assessment of opinions and a cooperative resolution of differences can educational planning move forward effectively in a democratic school system.

136 pages. $1.70. MicA 55-1008

THE RELATIONSHIP BETWEEN SOCIAL BACKGROUND FACTORS AND PARENTAL ATTITUDES ON SELECTED MATTERS OF DISCIPLINE IN THE HIGH SCHOOLS OF WASHINGTON COUNTY, PENNSYLVANIA

(Publication No. 11,601)

Harry William Morgan, Ph. D.
University of Pittsburgh, 1955

This is a study of the relationship between social background factors and parental attitudes on selected matters of high school discipline. The general method used is the analytical survey. The parents of senior high school students in Washington County, Pennsylvania, were surveyed by means of a questionnaire to determine certain attitudes pertaining to discipline. The investigation includes in its analysis:

1. The attitudes of all respondent parents on selected matters of high school discipline.
2. The relationship between social background factors and parental attitudes on general matters of discipline.
3. The relationship between social background factors and parental attitudes on the use of selected methods of punishment in the high school.
4. The relationship between social background factors and parental attitudes on selected methods of punishment for prescribed offenses in the high school.
5. The relationship between social background factors and parental attitudes on positive concepts of discipline in the high school.

Social background factors included for comparison in this study are: (a) sex of parent, (b) age of parent, (c) education of parent, (d) occupation of parent, (e) religion of parent, (f) number of children in high school, (g) national origin of parent, (h) family income, and (i) race of parent.

The results indicate that a majority of the respondent parents are desirous of having a proper discipline imposed on their youth because they believe that it has a transcending value in later life. They regard the school as the chief agency for the training of youth in modes of behavior, leaving to the school most of the discretion in matters of discipline. However, they seem to recognize their responsibilities as parents and stress the need for cooperation between home and school. The parents generally endorse the more modern concepts of discipline as opposed to the more arbitrary and authoritative measures. They favor a guidance concept of discipline, with emphasis on the individual, as opposed to a discipline of fear and harsh methods. Treatment of behavior as a phase of growth is emphasized with a case method for studying development along the same lines as mental and physical growth. The preventative aspects of discipline are emphasized, with stress on the more positive approach of training through school activities, such as the student council, and a greater reliance on community agencies as aids in the proper moral training of their youth.

There seems to be little difference in attitudes of parents by social background factor, except in the categories of education, occupation, and annual family income. The greatest number of differences occur in the application of methods of punishment to specific offenses. The least number of differences occur in connection with the positive concepts of discipline. The variety of punishments endorsed seemed to increase directly with the amount of education and the amount of family income. Among the occupational groups, the business and professional parents are most tolerant toward today's youth and least inclined toward severe measures. We may assume that sex of parent, age of parent, religion of parent, number of children, national background, and race of parent have little effect on attitudes on discipline, and that any home-school relationships in connection with conduct cases should be predicated primarily on the educational background, occupation, and income of the family.

331 pages. $4.14. MicA 55-1009

AN ANALYTICAL STUDY OF THE POSITION OF THE CITY SCHOOL SYSTEM AUDIO-VISUAL DIRECTOR

(Publication No. 11,207)

Kenneth C. Rugg, Ed. D.
Indiana University, 1954

Problem

The purpose of this investigation was to make an analytical study of the position of the full-time city school system audio-visual director. The study was designed (1) to reveal the professional characteristics of the position of the city school system audio-visual director, (2) to determine the relationship of the audio-visual director to the personnel of the city school system, (3) to identify the duties of the audio-visual director, and (4) to discover the emerging duty patterns of the audio-visual director.

This investigation was made in order that (1) useful information could be made available to institutions of higher learning committed to a program of professional education for the audio-visual director; (2) the general public as well as educators could better understand the scope of the work of the director; (3) job information could be provided to the prospective audio-visual director; (4) suggestions and information could be made available to individuals beginning or improving the city school system audio-visual program; and (5) there might be established a basis for further study which would encourage further professionalization of the audio-visual field.

Procedure

A postal card inquiry was sent to all (499) city school system superintendents in cities of 10,000 or more population located in the North Central Association geographical area and, from the 484 inquiries returned by the superintendents, it was learned that 66 city school system audio-visual programs were under the direction of one person who devoted full time to the task. Sixty of these directors furnished the data for this study by completing the Audio-Visual Director Information Form. These data were organized, conclusions were drawn, and recommendations were made. Several of the conclusions and recommendations are as follows:

Conclusions

1. The appointment of full-time city school system audio-visual directors began to gain momentum at the close of World War II.
2. While annual salaries ranged from a low of $3,000, three fourths of the directors received $5,000 to $8,000 or more and, in most instances, they received more salary than they would have received for serving as a teacher in the same school system.
3. Most of the directors were administratively responsible to the superintendent or the assistant superintendent of schools.
4. Cooperative effort on the part of many school system personnel was very much in evidence with respect to the assistance the directors received in carrying out the city school system audio-visual program.
5. The directors had a sufficient number of duties in common to insure implications for curriculum building in audio-visual education.
6. The directors believed they should produce a greater variety of audio-visual materials as well as assist teachers and others to produce them.

Recommendations

1. To attain maximum effectiveness, the city school system audio-visual program should be the responsibility of one professionally trained person.
2. The salary of the director should be greater than that of a teacher in the same school system, and he should receive a salary comparable to those of other supervisors and administrators with similar experience, training, and responsibility.
3. The audio-visual director should be administratively responsible to the official in charge of instruction in the school system – whether it be the superintendent, assistant superintendent, or curriculum director.
4. A careful study should be made to determine whether audio-visual directors are receiving adequate technical and clerical assistance.
5. Relevant data provided in this study should be made available to institutions of higher learning responsible for developing a curriculum for city school system audio-visual directors.
6. Directors should make available systematic teacher training in the preparation of inexpensive teaching materials in an area which has adequate physical facilities. 434 pages. $5.43. MicA 55-1010

CURRENT PHILOSOPHY AND PRACTICE OF INTERNAL PUBLIC SCHOOL RELATIONS IN LARGE CITY SCHOOL SYSTEMS

(Publication No. 11,605)

John Paul Schaefer, Ph. D.
University of Pittsburgh, 1955

This research deals with the philosophy and practice of internal public school relations in large city school systems, that is, the relations among the board of education, the superintendent of schools, his staff, principals, teachers, noninstructional employees, and students. Historical background of the problem was traced through the literature on public school relations.

Primary data for the study were collected by the interview method in 15 selected large cities of the United States. These data concerned philosophy, organization and administration, and media of internal public school relations.

Two philosophies, educational interpretation and cooperative endeavor in the interest of complete child welfare, were found in these cities with respect

to their overall programs of public school relations. The philosophy of internal public school relations in the 15 cities was found to be consistent with these two concepts.

In the organization and administration of internal public school relations, it was found that the superintendent of schools has the ultimate responsibility. He directs the program personally or delegates part of the responsibility to one or more members of his staff.

Media used in the program were found to include (a) activities in group situations of the board of education, school administrators, professional and noninstructional employees, and students; (b) publications and other methods for the dissemination of information; and (c) special techniques. These media implement in varying degrees the two concepts of educational interpretation and cooperative endeavor.

Based on the data obtained in these cities, the elements of a comprehensive program of internal public school relations were presented. This proposed program contains a statement of philosophy synthesized from findings in the literature and from the conceptual elements reported from the 15 cities. It sets forth a plan for the organization and administration of such a program. Suggested media to be used are presented and described briefly.

Conclusions and recommendations concerning the program of internal public school relations are summarized as follows:

1. The philosophy of internal public school relations was found to be more highly developed than its practice in the 15 cities. Efforts should be made to bring practice into closer agreement with prevailing philosophy. Increasing emphasis should be placed on the internal aspect of public school relations.

2. The program of internal public school relations should be well organized. Although the superintendent of schools is the key figure in the program, he may delegate part of his responsibility to qualified staff members. Those to whom responsibilities are delegated should have a deep understanding of people, since internal public school relations deal with such intangibles as morale and esprit de corps.

3. There is need for improved effectiveness of activities of professional employees in group situations. The superintendent's advisory council merits more serious consideration and greater attention to objectives and techniques than is evident currently. Where cleavages occur among employee groups, these cleavages should receive careful study to the end that they may be removed or ameliorated. The employment of large numbers of new teachers many of whom are products of nonpublic schools necessitates adequate orientation and in-service training.

4. In addition to professional school employees, other groups in the school system should be included in the program. Commensurate with their abilities, students should participate to a greater extent than at present. Means should be found to insure more active participation by noninstructional employees.

5. A strong program of internal public school relations may be expected to produce desirable effects on the education of children, on employee morale, and on relations with the community through the faith and confidence in the public schools reflected by those within the system.

197 pages. $2.46. MicA 55-1011

A STUDY OF EDUCATIONAL SPECIFICATIONS FOR PLANNING SCHOOL BUILDINGS: THEIR EVOLUTION, PREPARATION, AND CONTENTS

(Publication No. 11,375)

Russell Everett Wilson, Ph. D.
University of Michigan, 1955

This study of "Educational Specifications" as useful documents to be prepared in the process of planning school buildings has three major objectives: (1) to trace the evolution of the concepts underlying educational specifications; (2) to present an analysis of the authoritative recommendations and the actual educational practices relating to educational specifications; (3) to create a recommended content outline for educational specification documents.

At this time, when educators are concentrating their attention on the development of instructional programs and also on the planning of thousands of school buildings, it seems particularly desirable to study school building planning procedures which might be useful in creating more educationally suitable and efficient school buildings. Educational specifications which describe in detail a desired instructional program together with the student and community groups, their activities and their equipment, which will be involved in it can be helpful to educators and architects in their efforts to create a school building well fitted to a specific instructional program.

Three basic procedures were employed in this study: (1) a review of the literature related to educational specifications; (2) an analysis of the authoritative recommendations concerning the preparation and contents of educational specifications; (3) an analysis of the contents of actual educational specification documents. The first procedure provided information concerning both authoritative recommendations and actual practices in regard to the preparation and contents of educational specifications. In addition, some forty-eight actual educational specifications were collected as the result of a nationwide solicitation under the auspices of the National Council on Schoolhouse Construction. The second and third major procedures provided the information which was used in creating the recommended content outline for educational specifications.

It can be concluded from this study that: (1) the preparation of educational specifications by educators

as a regular school building planning procedure is well recommended by authorities in this field; (2) while the concept of educational specifications was developed some three decades ago, the actual practice of preparing them has occurred only in very recent years; (3) educational specifications should be substantial documents which describe in detail a desired instructional program and should be used in planning a specific school building project; (4) the preparation of educational specifications can be useful not only in school building planning but also can be beneficial in the development of instructional programs and in general administrative planning. 257 pages. $3.21. MicA 55-1012

EDUCATION, PHYSICAL

AN ANALYSIS OF AGGRESSION IN BOXERS, WRESTLERS, AND CROSS COUNTRY RUNNERS AS MEASURED BY THE ROSENZWEIG P-F STUDY, SELECTED TAT PICTURES, AND A SENTENCE COMPLETION TEST

(Publication No. 11,884)

Burris Frederick Husman, Ed. D.
University of Maryland, 1954

Supervisor: Dr. Warren R. Johnson

In order to determine the effect of college boxing and wrestling upon aggression, three projective type tests, the Rosenzweig P-F Study, six selected pictures of the Thematic Apperception Test, and a twenty-item Sentence Completion Test were administered to four groups of subjects under the following conditions:

1. Pre-season – a week or more prior to the official opening of practice for each sport.
2. Pre-contest – about half-way through the season and less than two days prior to an intercollegiate match.
3. Post-contest – less than two days following an intercollegiate match.
4. Post-season – one week or more following the last intercollegiate match of the season.

The Rosenzweig P-F Study was scored for direction of aggression and type of reaction. The six scoring factors analyzed were:

1. Extra-punitiveness – the aggression is employed overtly and directed outwardly toward the environment.
2. Intra-punitiveness – the aggression is turned by the subject upon himself.
3. Impunitiveness – the aggression is evaded by attempting to gloss over the frustration.
4. Ego-defense – the ego of the subject predominates (self-protection).
5. Extra-punitive ego-defense – the subject aggresses extra-punitively to protect himself.
6. Super-ego – the subject aggresses, and then is accused, charged, or incriminated against by someone else.

The Thematic Apperception Test (TAT) and the Sentence Completion Test (SCT) were scored for over-all intensity of aggression by rating the severity of the aggressive words expressed, and for direction by determining if the aggression was turned toward some person other than the hero (extra-punitive aggression) or toward the hero (intra-punitive aggression). High reliability of scoring was established for each test between the author and independent scorers.

The t test was utilized to determine if a significant difference existed between pairs of means of the scoring factors. Significant differences at the 5% level of confidence or better indicated that the boxers were less aggressive, less extra-punitive, and tended to be more intra-punitive and impunitive than the other groups. The cross country runners scored higher on the traits of ego-defense, extra-punitive ego-defense than the boxers, and both the boxers and cross country runners scored higher on super-ego than the control subjects.

In addition to the significant differences described above, some non-significant differences seemed to suggest tendencies in and among the groups. Indications were that participation in a varsity contest tended to lower the extra-punitiveness, ego-defense, and extra-punitive ego-defense means of the boxers and wrestlers, and caused them to turn their aggression inwardly. A season of participation seemed to cause the aggression of the participants to increase, as measured by the TAT; while the Rosenzweig P-F scoring factors of extra-punitiveness, intra-punitiveness, and super-ego tended to decrease.

It was concluded that the aggression of the boxers was significantly different from that of the wrestlers, cross country runners, and control subjects, and that a season of participation and a contest apparently had some effect upon the level of the aggression of the participants. Results of this study indicated that the most violent sports (boxing and wrestling) do not attract the most aggressive personalities. Substantiation was provided for both the cathartic and circular theories of aggression. The Thematic Apperception Test was judged by this investigator to be the best instrument for assessing aggression.

Future studies might well be conducted using the projective technique in other sport situations, which would contribute to the limited knowledge available concerning the psychological role of athletic sports. 174 pages. $2.18. MicA 55-1013

AN ANALYTICAL STUDY OF PHYSICAL FITNESS TEST VARIABLES

(Publication No. 11,522)

George Clark Moore, Ph. D.
University of Illinois, 1955

Seventeen physical fitness tests, involving forty-eight fitness variables were administered to ninety-eight male college students both at the beginning and at the end of a sixteen week physical conditioning course. The subjects were enrolled in P. E. M. 106, a service course designed for those students failing a three-item motor fitness test. Although considerably below average in motor endurance measures, the average standard score for the subjects on forty-one of the forty-eight variables was 43 standard score.

The purpose of the study was two-fold: (1) By means of the square root method of factor analysis, to isolate and identify the principal components or factors of the changes in thirty-six of these physical fitness variables following twelve weeks of physical conditioning.

The initial series of tests were used as the basis for a correlation matrix which was analyzed by the square root method of factor analysis to determine the primary factors in the battery. An analytic method of rotation of factors (the quartimax method) was used to reach orthogonal simple structure.

The changes in the tests scores (T-2 minus T-1) were computed and used as the basis for a second correlation matrix which was also analyzed by the square root method factor analysis and rotated to orthogonal simple structure.

Since the methods of factor analysis and rotation of factors that were used were relatively new, certain comparisions were made between these methods and the more conventional methods of graphic rotation of a centroid solution. A centroid solution rotated by the graphic method was compared with a square root solution and quartimax rotation of the same correlation matrix. Two of the four factors were found to be significantly alike and the other two factors were considered to be fairly similar. It was concluded that the two methods gave approximately the same results.

The conclusions, based upon the results of the study, were: (1) There were eight primary factors in the battery of forty-eight physical fitness measures used in this study. These forty-eight variables have been considered adequate measures of fitness and the factors obtained agreed with those found in other studies, consequently, the factors obtained in this study have been interpreted as real factors of physical fitness variables. These factors were:

(a) Constitutional Body Type
(b) Strength
(c) Pulse Rate Condition
(d) Energy of the Pulse Wave
(e) Total Body Reaction Time
(f) Expiratory Force (tentative)
(g) Motor Ability
(h) Thinness (tentative).

(2) There were six primary factors in the changes in test scores following a conditioning program. A moderate physical conditioning program can be expected to yield changes in the following areas:

(a) Changes in Strength
(b) Changes in Thinness
(c) Changes in Pulse Rate Condition
(d) Changes in the Energy of the Pulse Wave
(e) Changes in the Total Body Reaction Time
(f) Changes in Pulse Rate.

141 pages. $1.76. MicA 55-1014

A STUDY OF DIRECT MEASUREMENTS OF VENOUS PRESSURE IN REST AND DURING EXERCISE

(Publication No. 11,368)

William Nathaniel Wasson, Ed. D.
University of Michigan, 1955

The purpose of this study was to make a comparison of the validity of two techniques for measuring peripheral venous pressure. The study was concerned with whether measurement with the body in the erect position would give a more representative index of central venous pressure than with the body in the right lateral recumbent position. Supplementary problems were to determine the effects of training, such as preparation for a varsity athletic team upon venous pressure, arterial pressure and pulse while at rest, during exercise, immediately after exercise and ten minutes after exercise.

The bicycle ergometer was used for the standardized exercise. The venipunctures were made at the median basilic vein. In the erect position a moveable arm board that could be adjusted to the height of the subject's right auricle was used to hold the right arm in a fixed position. In the right lateral recumbent position the right arm was dependent and was clamped to a support to prevent the subject from moving it during the recording. A special table was constructed for the subject's body, with a head rest and an opening through which the right arm was made dependent.

Ten male students, ages eighteen to twenty-eight, who were in training for a varsity athletic team comprised the experimental group. Ten male students, ages eighteen to twenty-eight, who were engaged in sedentary occupations comprised the control group. Fourteen subjects were tested in both positions; the remaining six were tested in the right lateral recumbent position only.

A physician prepared the subjects for the venipunctures. The needle was placed in the median basilic vein and was connected, by means of a polyethylene tube, to the Electromanometer. The subject's fourth intercostal space was used as the zero pressure level in the erect position, while in the right lateral recumbent position, the right lateral border of the sternum, at the fourth intercostal space, was used.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

The following assumptions were made: 1) that exercise would cause a rise in venous pressure; 2) that the strenuosity of exercise would affect the rate and duration of rise in venous pressure; and 3) that peripheral venous pressure obtained with the subject in the right lateral recumbent position with the right arm dependent would give a more valid index of central venous pressure.

A significant difference was found between the resting venous pressures obtained in the erect position as compared with the pressures obtained in the right lateral recumbent position. Sixteen of the twenty subjects reached their peak of venous pressure within the first minute of exercise when tested in the right lateral recumbent position. No significant differences were found between the trained (experimental) and untrained (control) groups during exercise or recovery, in either position. There was little or no relationship between pulse rate and venous pressure.

The following conclusions were drawn from this study: 1) The right lateral recumbent technique gave a more valid index of central venous pressure than the erect technique. 2) No differences existed between the two groups with reference to changes in venous pressure during exercise or recovery. 3) The standardized exercise was more strenous in the right lateral recumbent position as indicated by the peaks which occurred within the first minute. There was no pattern for the increases which occurred in the erect position. 4) There was little or no relationship between pulse rate and venous pressure. 5) Exercise may or may not cause a rise in venous pressure.

153 pages. $1.91. MicA 55-1015

EDUCATION, PSYCHOLOGY

THE RECALL OF TRAIT ADJECTIVES ASSOCIATED WITH CONFLICTING RATINGS

(Publication No. 11,222)

Benjamin L. Candee, Jr., Ph. D.
The University of Nebraska, 1955

Adviser: Charles O. Neidt

Several current personality theories hold that verbal material which is "painful" is less easily perceived, learned, and retained than material which is not "painful". Other theories hold that verbal material which is in disagreement with an individual's self-concept or personal frame of reference is less easily perceived, learned, and retained than material which is in agreement with the self-concept. Since in real life situations painfulness and discrepancy are not easily disentangled, either explanation appears to fit many uncontrolled (clinical) observations.

The major purpose of this study was to find evidence pertaining to the comparative validity of these two theories.

Verbal materials whose assumed discrepant and painful characteristics for any given individual could be measured independently were selected. The materials were adjectives descriptive of personality traits. Each of the adjectives served as a label for one end of a nine-point rating scale. It was assumed that, when a subject rated himself on each of these scales and later received a purportedly valid external rating of himself on the same scale, the absolute value of the difference between the two ratings would be a measure of the discrepancy of the external rating with his self-concept. It was also assumed that the algebraic value of the difference (taking into account the direction of the external rating with reference to the individual's ideal) would be a measure of the painfulness of the external rating along a bidirectional "pleasure-pain" continuum. It was further assumed that through association with the external rating, each trait adjective would have its perceptual-acquisitional-retentional value affected in a manner similar to that in which the external rating itself was affected.

An experiment involving 295 students was conducted to obtain data for testing whether the above measures of painfulness and discrepancy were related to recall. Complete data were obtained for 84* of these students (58 women and 26 men). These data were used in the analysis.

Trait adjectives were used as response words in paired-associate learning, incidental to their use on the rating scales.

Recall measures were selected as criteria and other factors known to affect recall were controlled.

A discriminant analysis was applied to scores and ratings associated with each response word. No evidence of a relationship between the measure of painfulness and recall was found. No evidence of a relationship between the discrepancy measure and recall was found for male subjects on any of the words, and none for female subjects on 13 of the words. Evidence was obtained that better than chance prediction of recall-nonrecall for female subjects for three of the 16 adjectives could be made on the basis of the discrepancy measure.

Evidence regarding related problems was found as follows:

(1) The recall of incidentally learned materials was found to be positively related to the degree of ego-involvement under which the learning took place, even when the factor of attention was controlled.

(2) Post-learning verbalization, consisting of informing the subjects that the external ratings were not valid, was found to be followed by a significant gain in recall by men, but not by women.

(3) The frequency with which a word was recalled was found to be positively related to the familiarity of the word.

(4) The frequency with which response words, which were antonyms of the stimulus words, were recalled was found to be positively related to the relative frequency with which the words were elicited on a semi-free association test using the same stimulus words.

109 pages. $1.36. MicA 55-1016

*Data from more than 84 students were used in some analyses, but absence from experimental sessions and unavailability of control scores decreased the sample to this size for the major analyses.

THE INFLUENCE OF GENERAL AND SPECIFIC GOAL ORIENTATIONS ON INTENTIONAL AND LATENT LEARNING

(Publication No. 11,628)

Gloria J. Fischer, Ph. D.
Purdue University, 1955

Major Professor: Franklin J. Shaw

A general finding from latent learning experiments appeared to be that for a given situation, relatively weak motivation tends to be more favorable to latent learning than relatively strong motivation. Tolman's "broad" and "narrow" cognitive map concepts seemed uniquely appropriate to a theoretical explanation of such a finding. The latent learning finding itself suggested a reformulation of Tolman's map framework as a basis for prediction generally with respect to latent learning and also intentional learning.

Generally stated, the proposed reformulation or restrictive hypothesis was as follows: Conditions producing relatively unrestricted perceptual organization of the field would tend to be more favorable to latent learning than conditions producing relatively restricted perceptual organization of the field. Specific predictions were that 1). relatively unrestricted conditions would tend to be more favorable to latent learning than relatively restricted conditions and 2). relatively unrestricted conditions would tend to favor quicker learning of an intentional task, and under optimum conditions nearly equal over-all efficiency in learning it.

To realize these conditions a control group was given specific instructions to solve a task (restricted), while experimental groups were given the task only after various amounts of exploratory trials under general orientation (unrestricted). After solving the task, the groups were given a second task, similar to the first. These tasks yielded trials to criterion measures of intentional and latent learning.

The apparatus used was a letter punch board and stylus. When connection was made with the stylus, letters of the alphabet lighted. The tasks were words to be punched out. Five principles could be induced from punching which could greatly facilitate performance. It was expected, of course, that the generally oriented groups would be more likely to induce the principles than the specifically goal oriented group.

The trend of the relation between the amount of general orientation and learning appeared to be possibly linear, rather than cubic, as expected from an hypothesized function. A design similar to the present one was suggested to adequately test for the cubic trend.

Findings relating orientation to intentional learning, especially to intentional vs latent learning, tended to be consistent with predictions. General orientation did appear to produce quicker learning of an intentional task than specific goal orientation. Also, with optimum or less general orientation latent learning was not significantly less efficient than intentional learning. Since these findings were predicted from the restrictive hypothesis, they appeared to support it.

Findings were equivocal, however, where orientation was related to latent learning. General orientation did not produce a significantly greater amount of latent learning than specific goal orientation. On the other hand general plus specific goal orientation did produce a greater amount of latent learning than specific goal orientation alone.

Further consideration of the data suggested a possible interpretation consistent with the findings. This was that general orientation might be more favorable to latent learning in the sense of producing it more quickly. A design to test this hypothesis was proposed. Since such an hypothesis, if valid, would be consistent with the restriction hypothesis, the latter can not be said to have been adequately tested by the present study. To this extent the present study, is, perhaps, a less than adequate evaluation of the restrictive hypothesis.

From the obtained findings, the restrictive hypothesis, perhaps, would appear tenable, although modifications are indicated. These would appear to relate to more specific statements as to the conditions under which general orientation might be more favorable to latent learning than specific orientation.

67 pages. $1.00. MicA 55-1017

FACTORS ASSOCIATED WITH THE ACADEMIC ACHIEVEMENT OF FOREIGN GRADUATE STUDENTS AT THE UNIVERSITY OF MICHIGAN FROM 1947 TO 1949

(Publication No. 11,297)

Panos Timothy Hountras, Ph. D.
University of Michigan, 1955

PROBLEM

The major purpose of this study was to discover factors associated with the academic achievement of foreign graduate students. An extensive survey of the literature revealed that there was insufficient knowledge with respect to the qualities that distinguish

promising from less promising applicants for graduate study. The chief value of the present endeavor probably lies in the contribution it may make to the better selection of those foreign students who will profit most from graduate training. The conclusions as set forth in this project have emerged from the present inquiry into the achievement of foreign students enrolled in the Horace H. Rackham School of Graduate Studies of the University of Michigan during the academic years 1947 to 1949, inclusive.

PROCEDURES EMPLOYED

The principal sources of data are located in the office of the University's International Center, the office of the Registrar, and the Records Office of the Graduate School. These data were analyzed to determine the predictive relationship of selected personal, scholastic, and psychological factors to the academic achievement of the 587 foreign graduate students in the population represented in this project. Of this number, 257 were on probation at some time within their academic study. The remaining 330 were not on probation and therefore served as a "control" group. The chi-square, the Fisher-t, and analysis of variance were the principal statistical techniques used in order to determine the presence of any significant differences in the characteristics of the two groups.

CONCLUSIONS

Only the more important conclusions which emerged from the procedures described above will be mentioned here. They are as follows:

1. There was no significant association between achievement and such variables as sex, entering age, employment status, and summer school attendance.
2. There was a predictive relationship between achievement and such variables as marital status, type of admission, degree held at admission, and length of residence in the graduate school.
3. There was a significant relationship between geographical area and achievement. Students who came from the Near East, Latin America, and the Far East were more likely to incur probationary status than were students who represented other geographical areas.
4. There was a significant relationship between the field of study and achievement. Students who majored in the social sciences and physical sciences were more likely to incur probation than were the students who majored in other broad academic areas.
5. Some significant differences were found in the comparative performance of probationary and non-probationary students on the Miller Analogies Test and the Academic Aptitude Examination, Graduate Level. Almost without exception, the differences obtained favored the non-probationary students.
6. Finally, it should be noted that foreign students, by and large, were more likely to experience academic difficulities during the first and second enrollments than at any other time during their subsequent residence in the graduate school.

147 pages. $1.84. MicA 55-1018

ASCENDANCE-SUBMISSION IN THE PRESCHOOL CHILD AND IN HIS ADULT PERSONALITY

(Publication No. 11,300)

Sita Ram Jayaswal, Ph. D.
University of Michigan, 1955

The purpose of this study was to discover whether ascendance-submission in preschool children continues into their adult life.

Fifty-six former Merrill-Palmer Nursery School children (24 boys and 32 girls), whose average age is now 26 years, were contacted for purposes of this study. From the record files of these subjects early Merrill-Palmer ratings on an Ascendance-Submission scale, made by their teachers over a two to three-year period of time, were obtained. The subjects were asked to write a brief autobiography and to complete a self-rating on an adaptation of the Ascendance-Submission scale. The parents of these subjects were also contacted and were requested to rate them on this scale as they remembered them to be as young children. Thus, in assessing ascendance-submission in the preschool child's personality the devices employed were: the early Merrill-Palmer ratings on the Ascendance-Submission scale, the autobiography, self-ratings on ascendance-submission based on memory, and the ratings by the parents on ascendance-submission, also based on memory.

For the assessment of ascendance-submission in the adult personality of these subjects, The Guilford-Martin Inventory of Factors GAMIN (Abridged Edition) was selected. The factor A in GAMIN was assumed to fit quite well the definition of ascendance-submission adopted for this study. Another measure to assess ascendance-submission in the adult personality was the F Scale (Adorno).

On the basis of the findings of this study the following conclusions are drawn:

1. Statistically, in terms of the total group, there is no significant relationship between ascendance-submission, as measured, in the preschool child and in his adult personality.
2. Assuming that the midpoint of the 7-point scale is the neutral point, the individual case approach shows that 70 per cent of the individuals studied tended to follow their personality pattern of ascendance or submission from childhood to adulthood. This "persistent" group included 71 per cent of the women and 66 per cent of the men.
3. When the actual mean placements on the 7-point scale rather than the midpoint 4 were taken as the neutral point, only 54 per cent of the cases showed persistence in the trait. Thus it appears that in some individuals the tendency to be ascendant or submissive persists, in others varying degrees of change in one direction or the other take place as they grow to adulthood. Only the intensive longitudinal study of individual cases can reveal the factors which underlie persistence or change.
4. The subjects' own and their parents' memories of early childhood personality patterns differ significantly from ratings made by observers at the time.
5. There is no relationship between ascendance and authoritarianism as measured by the instruments used.

99 pages. $1.24. MicA 55-1019

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

A COMPARATIVE STUDY OF THE APPERCEPTIONS OF TWO GROUPS OF ELEVEN-YEAR-OLD BOYS WHOSE FATHERS ENGAGE IN PROFESSIONAL AND SEMI-SKILLED OCCUPATIONS RESPECTIVELY

(Publication No. 11,475)

Dorothy Carel S. Laird, Ed. D.
The University of Florida, 1955

The ultimate purpose of this research is to augment the relatively meager literature on eleven-year-old boys by contributing data on subtle inner processes which are shaped partly by developmental forces and partly by continuous interaction with environmental forces.

The design permits a dynamic and molar approach to the study of this age-sex group by a comparative analysis of the apperceptions of two groups of boys drawn from two different universes and influenced by a major variation in the outer environment.

The two groups, designated as the P group and the S group, are each composed of 19 boys whose fathers engage in professional or in semi-skilled occupations respectively. The two groups are similar in chronological age, general intelligence, physical status, race, and nationality. The boys in both groups live with real parents, have at least one sibling, and have resided in the Gainesville, Florida, area for at least four years.

The two groups differ markedly in occupational status of fathers, in education of both parents, and in income rating of fathers.

The three instruments utilized in data collection – The Wechsler Intelligence Scale for Children, the Rorschach, and the Story Apperception Test – are deemed appropriate to the theoretical foundations of this research.

From a comparison of the differences and similarities in the apperceptions of the P group and the S group, it is evident that:

1. The predominant difference is the differences in basic psychologic structure which gives direction and character nuance to all concomitant processes. The S group typically manifests an extratensive pattern, while the P group reflects a variation in patterns, with no one pattern being typical. Although the major variation in the outer environment partially accounts for this difference, one cannot exclude the influence of constitutional endowment.

2. Other differences between the two groups in apperception of inner and outer worlds reflect more directly the differing physical and cultural components in the outer environment. For example, the S group manifests a desire to improve the physical aspects of the home environment, while the P group is more concerned with other aspects of the outer world.

3. The most important similarities are the intense feelings of anxiety and the definite neurotic character structures which are manifested by the greater proportions of each group. Since the degrees of neurotic character structure and the intensities of anxiety experienced by the two groups are similar, many of the differences in the apperceptions of inner and outer worlds can be attributed to the differences in psychologic structure and, hence, to the manner in which these tensions are handled.

4. A few of the similarities in the apperceptions of the two groups which might be considered typical of most eleven-year-old boys in this geographical area refute some of the findings of previous research. For example, more than one-half of the combined group manifests emotional acceptance of girls, while only five per cent project definite emotional rejection. Consequently, the assumption that sex antagonism is typical of this development level might be questioned.

Other similarities either substantiate previous research or enhance it by providing additional insights into the private worlds of similar groups of eleven-year-old boys. 369 pages. $4.61. MicA 55-1020

A FACTOR ANALYSIS OF THE LINCOLN-OSERETSKY MOTOR DEVELOPMENT SCALE

(Publication No. 11,362)

Paul Fredrik Thams, Ph. D.
University of Michigan, 1955

The test used in this study is essentially an American adaptation of the Oseretsky Test of Motor Proficiency. It has been felt that the scale shows promise of acceptance as a clinical tool which can be used as one part of an individual assessment of the child. All researches, however, have been conducted on the assumption that six areas of motor proficiency are measurable as groups within the structure of the test battery.

The test was recently standardized on a small American population, and in order to determine whether or not six areas are present, the test battery, consisting of forty-six subtests, was administered to those 211 males in the standardization group who fell between the ages of seven years six months and twelve years five months. Each subtest, plus each subject's age, was correlated with every other subtest and the resulting coefficients were placed in a correlation matrix which served as the basis for the factorial study. The matrix was factor analyzed using Thurstone's centroid method of multiple factor analysis. Factorization was carried out through six factors. A combination of tests for completeness of factorization indicated that factorization was complete at that time. A further check indicated that factorization actually had been complete after the extraction of the first factor. It was noted, however, that the first factor accounted for only 19.98 per cent of the variance. It was concluded that, on the basis of the evidence collected and the analysis made, there was no clear-cut case for the presence of six factors in this study. Since a single factor accounted for the correlation matrix, the matrix was assumed to be of unit rank. The factorization was repeated utilizing the Spearman technique for extracting single-common-

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

factor loadings. The pattern and magnitude of factor loadings obtained was essentially the same as the first factor loadings obtained in the multiple factor process. This strengthened the conclusion that the study was essentially a single factor problem. Examination of the factor loadings and an informal examination of the tests contributing most to those loadings indicated that the single factor was general in nature. An item analysis, in which individual scores were correlated with total scores, showed that the scale was significantly discriminative.

The formal conclusion of the study was that within the limitations of the study, and with the population examined, there is not sufficient evidence to indicate that six factors are measured. There is, rather, more evidence that a single general factor was measured. Since the single factor accounts for such a small percentage of the total variance, the recommendation is made that rather extensive validation studies of the Lincoln-Oseretsky Motor Development Scale be carried out. It is felt that such studies will be necessary before the scale can be used as a diagnostic tool on an individual.

193 pages. $2.41. MicA 55-1021

A VALIDATION OF NEW MEASURES OF ELEMENTAL BEHAVIOR: (A STUDY OF DR. STUART A. COURTIS RATIO SCORES)

(Publication No. 11,387)

Charles Clinton Yarbrough, Ed. D.
Wayne University, 1955

The score an individual makes on any educational or psychological test is determined by many factors. For this reason, Dr. Stuart A. Courtis, a pioneer in the field of educational testing, states that no test measures what it appears to measure.

In an attempt to procure the measure of a single variable, Courtis devised the "ratio score" technique.

Courtis hypothesizes: A rate test can be devised so that administration with one set of directions will yield a score determined by N factors. A second administration, with altered directions, will yield a score determined by N + 1 factors. Division of the second score by the first score will provide a quotient, the Courtis ratio score. This division is, Courtis avers, the cancellation of the common factors, and the ratio would, therefore, be a measure of the factor added in the second administration of the test.

To implement this theory, Courtis created the Courtis Ratio Tests which provide, as a final score, an Achievement Status Index (ASI) which is purported to measure ability to achieve. A basic component of the ASI is the ratio score measurement of the "ability to think, an element of human nature." This is termed Quality Index (QI).

A study of ratio scores, both in theory and in practice, was deemed to be of interest and importance in the field of educational measurement.

The first part of this study is devoted to obtaining an indication of the nature of the Quality Index score from the Courtis Ratio Tests by means of a multiple factor analysis. An experimental testing program was designed to permit comparison of the QI score with scores from standardized tests of the California Series. Each test was administered twice; the mean score was considered as the actual score. A 20 x 20 correlation matrix provided a factor analysis which yielded seven well defined factors. Two of these are related to the higher mental abilities: Verbal Reasoning on which the Courtis Quality Index has a loading of .47, and Precise Thinking on which the QI shows .29. Correlation betweem these factors is represented by a cosine of .06.

The correlation matrix also indicates the QI to be a measure of reasoning; correlations between the QI and Reasoning is .55, between the QI and Problems is .45.

The second part of this work deals with a deductive, mathematical study of the ratio score theory.

Because cancellation is assumed by Courtis in the quotient score which he terms a ratio score, his theory of Factor interaction to produce an observed score X will be:

$$(1)\quad X = E_1F_1 \times E_2F_2 \times E_3F_3 \times \ldots \times E_nF_n.$$

The E values are the error attached to each factor.

This equation can be generalized as

$$(2)\quad X = E_fT.$$

The multiplicative theory of factor interaction is shown to be feasible; the mean of the true score T equals the mean of the observed score E. Further, the error of this theory is directly related to the absolute error of the conventional additive theory of factor interaction expressed as:

$$(3)\quad X = T + E_a.$$

It has been determined that:

$$\sigma^2_{E_f} = \frac{\sigma^2_{E_a}}{\sigma_T{}^2 + \bar{T}^2}.$$

The ratio score, being a quotient score, could be expected to lack the reliability of either of the scores used to create the quotient. Study of the conditions surrounding the administration of the tests by mathematical deduction indicates that ratio scores are not unduly error ridden.

229 pages. $2.86. MicA 55-1022

EDUCATION, RELIGION

AN ANALYSIS OF PASTORAL COUNSELING NEEDS AND TRAINING IN TWO CHURCH DENOMINATIONS

(Publication No. 11,148)

Cornelius Oldenburg, Ph. D.
Michigan State College, 1954

The study was designed to investigate and appraise the needs and the extent of training for pastoral counseling of active ministers in the Methodist and Presbyterian denominations. It was further desired to determine to what extent the seminaries of the two denominations had prepared their trainees for the specific task of pastoral counseling.

The selection of the two denominations was based upon their particular size, constituency and because the one was more semi-urban and the other more urban; because one demanded full-time seminary work from its prospective ministers for ordination and the other permitted ordination either upon completion of a three year seminary course or upon graduation from an accredited college or university after having taken the prescribed courses within the district where the minister lived.

In order to appraise the difference within the denominations respectively, the selected groups of ministers were divided into two main categories; those graduating between the years 1928 and 1940, and those graduating between the years 1941 and 1952, inclusive. The normative survey was the technique employed for obtaining the data. One questionnaire was constructed which included these principal topics: problems which a minister meets in counseling with his parishioners, the number of years of training in courses which meet the most satisfactory needs for pastoral counseling, the seminary courses considered the most valuable to meet those needs, and the seminary courses which needed emphasis in the training program. The other questionnaire which was sent to the seminaries was concerned with the following: courses which were taught and the number of semester hours assigned to each course, whether courses related to pastoral counseling met the needs for an effective ministry, specific strengths and weaknesses in the courses offered, improvement which staffs could recommend in courses offered, and space for suggestions and comments. Each of these questionnaires was introduced with a cover letter.

The sample was selected by use of a table of random numbers from the active ministers in both denominations falling within the limits of the graduating groups, and the study was made on a nationwide basis in order that the information received might be construed as comprehensive as possible. A copy of the questionnaire was sent to each of the ministers sampled and to each seminary of the denominations. The respondents were requested to rate the items in relation to their effectiveness for the pastoral counseling program. Approximately 50 per cent of the respondents returned the completed questionnaires.

The responses were tabulated in terms of percentages of the total number of ministers responding and the seminary results were indicated in figures and quoted responses or check lists.

Results of the findings as presented by the active ministers responding were as follows:

1. There was evidence of a trend toward more emphasis on pastoral counseling training. This was particularly expressed by the ministers responding.
2. Methodist and Presbyterian rural ministers responded that parishioners came to them more often when a loved one passes away or a member of the family is hospitalized than with any other problem.
3. There seemed to be an awareness by the respondents that training in pastoral counseling was needed, especially when they were faced with emotional, educational, and vocational problems.
4. The rural areas of the 1928-1952 and the urban 1928-1940 graduating groups in both denominations realized the need for more counselor training programs, whereas the urban 1941-1952 graduating groups had already realized the need to some extent.
5. In responding to the number of years of training needed in courses related to pastoral counseling, there seemed to be a very strong trend on the part of the great majority of ministers responding that such courses be given more emphasis.
6. The Presbyterian ministers of the urban 1941-1952 graduating classes were less satisfied with the seminary courses offered in relation to pastoral counseling than were the Methodist urban ministers of the same graduating classes. The reverse was true in the rural groups. Therefore, added training in pastoral counseling programs appears to be needed.
7. Although in most cases the historical, traditional theological course offerings were regarded as having some value for pastoral counseling, a small group of ministers indicated that they felt them to be almost wholly unrelated.
8. A large percentage of the respondents stated that courses relating to pastoral counseling needed more emphasis.

Findings relative to the responses from the seminaries were:

1. All the seminaries responding felt the need and the importance of pastoral counselor training.
2. Most of the seminaries responding indicated by checking that their courses were somewhat adequate with a few stating that they were less adequate.
3. More Presbyterian seminaries presented course offerings relating to pastoral counseling than was found in the Methodist training programs.
4. Instructional patterns relative to pastoral counseling and related courses vary from one seminary to another depending upon organization and administrative conditions.
5. There is evidence of a trend in the direction of adding and integrating course offerings in the seminaries to meet the total need of pastoral counseling training.
6. A need for more technically trained men as instructors and ministers is very apparent from responses received.
7. Apparent weaknesses and inadequacies in

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training for pastoral counseling were evident in the responses given by some of the seminaries.

Further research and study should be made to determine the effectiveness and the comprehensiveness of pastoral counseling course offerings. A study should be made to determine the qualifications and special training needed for personnel now teaching in seminaries, and those who expect to teach courses related to pastoral counseling. Further research is needed to determine the nature and content of pastoral counseling courses to meet the requirements for this function. This would necessarily involve a more intensive study of present course offerings in the summaries than was made in the present investigation. 171 pages. $2.14. MicA 55-1023

EDUCATION, TEACHER TRAINING

THE HISTORY AND DEVELOPMENT OF THE ALL-DAY NEIGHBORHOOD SCHOOLS IN THE NEW YORK CITY PUBLIC SCHOOLS

(Publication No. 10,658)

Adele Franklin, Ed. D.
New York University, 1954

This study is a report on the experience gained in the development of the All-Day Neighborhood Schools, a program operating in four elementary schools (Kindergarten through sixth year) of the New York City Public School System. The All-Day Neighborhood Schools have broad objectives, viz., the enrichment of the school day, its extension after three o'clock and the development of closer home-school-community relations. The analysis of the methods employed together with an evaluation of the effectiveness of these schools suggest possibilities of adopting similar programs elsewhere.

In order fully to highlight the significance of the program its historical setting is given in a brief summary of trends in America's educational tradition. The aims, objectives and procedures devised to carry them out, are presented in the chronology in which they developed. Aims and objectives changed and were modified to meet changing school situations.

These data are presented with illustrations from teachers' logs and from reports. The methods by which changes came about and the relationship between the schools and their respective communities are recorded. Selection has been made of those typical of general practices that have been accepted by these schools. The study contains examples of types and kinds of curricula that meet the needs of the children in the varying communities in which these schools are located.

An evaluation of the effectiveness of the programs in terms of child development, amount and kind of change in curriculum and changes in teacher attitudes, has been based on a study of teachers' logs and an analyses of records of observations by the investigator and other professional personnel in the school. The types and kinds of integration of home, school and community have been summarized.

A study of these records furnished data that have significance in the following areas:

1. Extended use of the school plants – There is an increasing need for the extension of the school day and extended use of school plants. Services to increase physical, mental and social fitness are an accepted part of school programs today. The rising cost of buildings, the shortage of facilities for recreational activities, the need for day-care centers, the increased crowding in our urban areas and a rising birth rate all signify the need for the extended school day and a wider use of the school plants. The program of the All-Day Neighborhood Schools illustrates an extension in the use of school plants.
2. The rising tide of juvenile delinquency – Juvenile delinquency is in the headlines of the newspapers and is the subject of endless discussions and study. In the All-Day Neighborhood Schools there is a notably low rate of truancy and delinquency. The evidence for that statement has been included in this study.
3. Dual function of the elementary school today – The program of the All-Day Neighborhood Schools has developed certain techniques for implementing the dual function of the school. They include (1) the use of the personnel in the enriched program of the school day as well as in the extended school day; (2) the close relation of these schools with community agencies (social work, health, recreational organizations, parent and citizen groups).
4. Importance of citizen interest and participation in public education – Recognition of the necessity of securing citizen interest and participation in improvements in public education is growing. The way in which this plan, first supported by a private organization of lay citizens, was adopted by a public school system illustrates the effectiveness of citizen participation. 346 pages. $4.36. MicA 55-1024

A NUTRITION GUIDEBOOK FOR ELEMENTARY SCHOOL TEACHERS

(Publication No 10,660)

E. Curtiss Gaylord, Ed. D.
New York University, 1954

The Problem

It is the purpose of this study to develop a guidebook of critically selected materials and suggested procedures for nutrition education at the elementary level, written in appropriate language for grade school teachers. It aims to show how nutrition may be effectively taught by integration into the whole curriculum.

The problem in this investigation is threefold:

1. To select useful materials for teaching nutrition in the elementary school.

2. To select suitable procedures for teaching nutrition in the elementary school.
3. To adapt into a guidebook the selected procedures and materials about nutrition.

Background

During the past six calendar years, this investigator has been teaching nutrition to prospective teachers for our elementary and secondary schools as well as to in-service elementary teachers. This writer has been impressed with one main idea, namely, that there is considerable room for improvement in nutrition education at the elementary level. The question arose, what can be done about it?

To meet this recognized need it became apparent that an appropriately constructed guidebook might partially contribute to improvement of nutrition education. By suggesting objectives, methods, materials, and resources the guidebook would assist the elementary teacher to improve the health knowledge, attitudes, and habits of her pupils.

Thus the competent grade school teacher, with an appropriate nutrition guidebook, could better help her pupils to a healthier and happier life.

Procedure

Accepted library and documentary procedures were used in the four major steps of the investigation – (1) establishment of goals of nutrition education, (2) selection of materials based on the goals of nutrition, (3) selection of teaching methods which can be used with the materials, and (4) adaption of goals, materials, and methods into the Guidebook.

The Guidebook was developed in two parts. Part I, The Investigation, included Chapter I, The Problem; Chapter II, Need for the Study; Chapter III, Related Studies; and Chapter IV, Procedure. This was followed by a bibliography of references used in the investigation.

Part II, the Guidebook itself, began with an introductory chapter which included the point of view that nutrition education can serve as a springboard to the teaching of other aspects of an elementary school health education program.

Chapter V discussed the importance of good food to health. Many quotations were included from authorities in the field on the importance of nutrition. Material was included relating nutrition to growth, longevity, pregnancy, dental health, mental responses, prevention and treatment of illness, and other aspects of nutrition.

Chapter VI discussed the problem of forming good food patterns. Emphasis was given to CREATING A HEALTHY INTEREST IN EATING, rather than URGING CHILDREN TO EAT.

Chapter VII included a listing of the Goals for Nutrition Education as developed by the Department of Nutrition, Harvard School of Public Health, under a grant-in-aid from the Nutrition Foundation, Inc.

Chapter VIII was devoted to finding the dietary and health needs of children. Positive and negative signs of nutrition of health were listed. The use of the child's cumulative health folder, daily health observations, food pattern surveys, questionnaires, and interviews were included. In helping further with the needs, the Basic Seven Foods were discussed.

Chapter IX included a presentation of some suggested methods and techniques of teaching nutrition. Some approaches included direct teaching through nutrition units, correlating nutrition in other subject fields, the problem solving approach, incidental teaching, the school lunch, and films and filmstrips. Suggestions for securing home and community participation were also emphasized.

Chapter X was devoted to evaluation of nutrition education.

The annotated bibliography contained selected and graded materials for the elementary school teacher. Types of materials included are: books, booklets, pamphlets, leaflets, posters, charts, films and filmstrips. 300 pages. $3.75. Mic 55-97

THE DEVELOPMENT OF A TEACHER EDUCATION CURRICULUM IN INDUSTRIAL EDUCATION WITH ESPECIAL EMPHASIS UPON INDUSTRIAL INTERNSHIP

(Publication No. 7135)

Withro McEnge, Ed. D.
New York University, 1953

Chairman: Professor William P. Sears

This study was undertaken; (1) to trace the needs and requirements of future teachers of industrial education; (2) to study the course offerings of some of the institutions offering industrial teacher education; (3) to project for Tuskegee and similar institutions a program of training for prospective teachers of industrial education.

To secure data for the first and third objectives the investigator designed and sent an opinion questionnaire to the following groups: administrators in education, members of labor and management, and graduates of the School of Mechanical Industries, Tuskegee Institute.

In pursuit of the second aim of the study a letter requesting the objectives and a list of the course offerings in industrial education was sent to 141 Deans or Presidents of American colleges and universities having programs in industrial teacher education.

The data obtained from the foregoing sources pointed out that:

1. Industrial education embraces both industrial arts and vocational-industrial education, the former being a phase of general education, and the latter emphasizes specialized training in trades and industries.
2. The industrial teacher education curriculum should be projected in accordance with the industrial technological developments of the nation, and seek to develop an understanding and an appreciation of labor-management relationships and of socio-economic benefits.

3. From two years to eight years of trade and industrial experience are required of trade teachers to be certified for bona-fide subsidized programs and it is desirable for all other teachers of industrial subjects to secure some industrial work experience before being certified.

4. Data from the respondent educators showed that 76.36 per cent of them represented institutions that do not have any programs of industrial internship; 61.11 per cent indicated that the industrial internship program should become a college requirement of the industrial teacher curriculum.

5. There is a need for the industrial teacher training institutions to begin selling the industrial internship program to members of labor and management. Many of the latter have manifested a willingness to cooperate in setting up and supervising such training programs.

6. Members of both labor and management see a need for both the apprenticeship and internship programs, since the objectives of these two programs are entirely different.

7. Fifty-eight per cent of the respondent educators indicated a need for the fifth year program or the use of summer internships in lieu of the fifth year.

The composite data of respondents were used to project the program which was the ultimate objective of this study. The inclusion of general education, professional, and technical courses was determined by the frequency of their occurrence in the curricula of the participating colleges and universities. From the forementioned data the investigator also evolved the following plans of alternation between college training and industrial internship:

A. A four-year college training program which includes two three-month periods of internship as part of the four-year industrial teacher curriculum.

B. A five-year industrial arts curriculum which includes twenty-one months of organized work experience, one quarter of practice teaching, ten quarters of training in general education and professional courses, and training in ten different technical shop subjects.

C. A five-year vocational-industrial education curriculum including the same amount of general and professional education, and periods of industrial internship as does the industrial arts curriculum. The latter requires training in several industrial shops, but the student enrolled in the vocational-industrial education program will devote to one shop all of the required time allotted for the shops experiences.

336 pages. $4.20. MicA 55-1025

A STUDY OF STUDENT TEACHING PROGRAMS IN ELEMENTARY EDUCATION IN THE LIGHT OF SELECTED PRINCIPLES WITH SPECIAL EMPHASIS BEING GIVEN TO THE STUDENT TEACHING PROGRAM IN THE PHILIPPINE NORMAL COLLEGE

(Publication No. 11,211)

Pelagia Untalan, Ed. D.
Indiana University, 1954

Problem. The purpose of this investigation was to study various student teaching programs in elementary education in the light of selected principles that should guide a program of student teaching. The student teaching programs studied were as follows: State Teachers College, Oneonta, New York; Ball State Teachers College, Muncie, Indiana; Indiana State Teachers College, Terre Haute, Indiana; School of Education, Indiana University; Philippine Normal College, Manila, Philippines.

Procedure. The investigator reviewed literature concerned with student teaching programs in elementary education in an effort to ascertain principles that should govern a student teaching program. As a result of this study twenty-two principles were formulated. An attempt was then made to discover ways in which these principles were implemented in five teacher education institutions. A guide sheet was prepared in order to facilitate interviews in connection with each of the principles. Interviews were conducted with selected personnel in each of the institutions included in the study.

Conclusions.

1. Teacher education institution and public school personnel are recognizing increasingly their joint responsibilities in the preparation of elementary teachers. These responsibilities range from the recruitment of teachers to the in-service education of teachers.

2. It is highly important for the objectives of student teaching to be stated specifically and in terms of behavioral outcomes.

3. Limited use is being made of guided professional laboratory experiences prior to student teaching.

4. A full-time student teaching program provides excellent opportunities for a student teacher to participate with increasingly greater amounts of responsibility in the instructional as well as non-instructional functions of a teacher.

5. The optimum professional growth of a student teacher should provide the basis for determining when and the extent to which a student teacher should engage in observation, participation or actual teaching experiences.

6. Method teachers should actively participate as resource people in a program of student teaching so that they may be of maximum assistance to student teachers and supervising teachers.

7. Student teaching programs do not seem to make maximum provisions for differences in the abilities and needs of individual student teachers.

8. A full-time student teaching program seems to have many advantages over a part-time program.

9. Student teachers in elementary education normally have limited opportunities to gain intensive student teaching experiences with pupils of different grade levels as well as socio-economic levels.

10. Supervising teachers seem to feel that their pupils profited as a result of having student teachers assigned to them.

11. Limited use is being made of seminars and small group conferences held during the period of student teaching.

12. There seem to be wide acceptance among teacher educators of the value to be derived by student teachers from self-evaluation.

13. The most commonly used methods for promoting continuous self-evaluation in student teaching seem to include daily diaries written by the student teacher, rating scales upon which the student teachers appraise themselves, and various types of conferences between student teachers, supervising teachers and college personnel.

14. Off-campus student teaching presents major problems in the supervision of student teaching especially when the college supervisor has to travel great distances.

15. Some undesirable variations in the selection of cooperating schools and supervising teachers seem to result from the absence of appropriate printed policies.

16. Teacher education institutions and the cooperating public schools seem to work together as harmoniously as possible in providing desirable experiences for student teachers.

17. Wide variation exists in the compensation and/or recognition given supervising teachers and other public school personnel who assist with student teaching. 417 pages. $5.21. MicA 55-1026

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

ENGINEERING, AERONAUTICAL

HYPERSONIC VISCOUS FLOW OVER A FLAT PLATE

(Publication No. 10,994)

Ronald Filmore Probstein, Ph.D.
Princeton University, 1952

The steady, hypersonic laminar flow over a semi-infinite flat plate oriented in the free stream direction is examined, the immediate region around the leading edge being excluded from the treatment. As a result of the curvature of the relatively thick boundary layer, a sufficiently large outward streamline deflection is induced to bring about an important change in the "effective" geometric shape of the body, with the result that pressure variations are propagated into the main stream along Mach lines. This "external" pressure field in turn "feeds back" into the boundary layer and affects its rate of growth. Asymptotic solutions are obtained by "working upstream" from a location far downstream of the leading edge. Within the region where these asymptotic solutions are valid, it is shown that the interactions between the Mach waves generated by the growth of the viscous layer and the shock wave from the leading edge are negligible, so that the "external inviscid" flow can be regarded as an isentropic flow across a single family of characteristics (Prandtl-Meyer flow). In spite of their asymptotic character, the solutions obtained turn out to be good approximations over a considerable portion of the plate surface.

This analysis brings out a significant hypersonic viscous flow parameter, which is a measure of the magnitude of the pressure variations produced in the external flow by the viscous layer. This parameter is the product of the free stream Mach number and the streamline inclination induced by the zero pressure gradient, flat-plate boundary layer flow, or the quantity $M_\infty^3 / \sqrt{Re_{x^*}} \equiv X$, for $M_\infty >> 1$, where M_∞ is the free stream Mach number and Re_{x^*} the Reynolds number based on distance from the leading edge. Solutions of the complete Navier-Stokes equations are obtained as asymptotic series for the velocity and temperature in ascending powers of $M_\infty^3 / \sqrt{Re_{x^*}} \equiv X$. In this scheme the zeroth approximation is the usual zero pressure gradient, flat-plate flow. With the aid of these asymptotic solutions it is shown that the so-called higher order viscous and heat conduction terms in the x-momentum and energy equations are negligible in a wedge-like domain extending from the leading edge, where $M_\infty^2 / \sqrt{Re_{x^*}}$ is small compared to unity. The centrifugal force or pressure gradient normal to the plate is no longer negligible when the parameter M_∞^6 / Re_{x^*} is not small compared with unity; it therefore must be considered when the second approximation or terms of order X^2 are examined. To terms of the order of $M_\infty^3 / \sqrt{Re_{x^*}}$ the surface pressure distribution is identical with the distribution calculated from the normal velocity field induced by the zeroth order or ordinary flat plate boundary layer growth. It is given by $p_s^*/p_\infty^* \approx 1 + [.865(T_w/M_\infty^2) + .166(\gamma - 1)]X$, where p_s^* is the surface pressure, p_∞^* the free stream pressure, γ the ratio of specific heats and T_w the ratio of absolute wall to free stream temperature.

By iterating between the "internal" and "external" fields the Navier-Stokes equations are reduced to a series of ordinary, linear, inhomogeneous second order differential equations for the coefficients in the asymptotic series. In order to simplify the work, the Prandtl number is taken as unity at first and a linear viscosity-temperature relation is employed. The energy equation transformed by means of the asymptotic expansions is shown to yield a generalization of the Crocco-Busemann integral (for Prandtl number one) for the case of a self-induced pressure gradient. Numerical results are obtained in terms of integrals involving the zeroth order solution which are tabulated once and for all. For practical application the flow variables are then computed simply by inserting the necessary constants. To illustrate the results examples for Prandtl number unity are worked out in detail.

The first-order correction to the velocity and temperature profiles, skin friction and heat transfer rate as a result of the "self-induced" pressure gradient are calculated. It is found that although the induced pressure gradient may become quite large, the heat transfer rate remains relatively unaffected, even for values of $M_\infty^3 / \sqrt{Re_{x^*}}$ of the order of five; actually it is decreased slightly. The local skin friction coefficient is however increased more than 20% for the same order of $M_\infty^3 / \sqrt{Re_{x^*}}$ with $M_\infty \leq 10$ and a ratio of well to free stream temperature of five; for a constant value of $M_\infty^3 / \sqrt{Re_{x^*}}$ this effect decreases with increasing Mach number and is less than 10% at $M_\infty = 20$. For a constant $Re_{x^*} = 10^6$, at $M_\infty = 10$ ($X = 1$) the increase in local skin friction coefficient is approximately 4%, while at $M_\infty = 20$ ($X = 8$) the increase is approximately 15%. The velocity and temperature profiles are considerably altered from the zero pressure gradient solution, and all effects noted previously are increased when the ratio of wall to free stream temperature is increased at constant Mach number.

It is shown how the methods developed can be extended to the case of Prandtl number different from unity, to the case of fluid injection, and to the hypersonic flow over a flat wedge. In addition, it appears that the present approach may also be applied to a cone or straight cylindrical surface with its axis oriented in the flow direction.

116 pages. $1.45. MicA 55-1027

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AERODYNAMIC DESIGN OF HELICOPTERS

(Publication No. 11,377)

Karl Dawson Wood, Ph.D.
University of Michigan, 1955

An integrated series of helicopter performance charts is developed covering hovering, level flight, climb, glide, and landing without power.

The method used is a mathematical synthesis of theoretical equations with empirical coefficients to put the desired results in a form readily usable by engineers in making design compromises.

The assumptions involved in the theoretical equations are reviewed; only widely accepted assumptions and equations are involved.

Two basic series of charts are involved: 1) two new types of hovering power charts, and 2) a novel series of general charts for power required for level flight.

The hovering power charts permit quick estimates to be made of the hovering power required as a function of various parameters, including solidity, disc loading, and tip speed with specified limits on retreating blade stall and advancing blade shock wave loss, and indicate the areas in which power-off landings may be hazardous.

The level flight charts consist of 1) a series of general charts of power required for level flight, expressed in terms of hovering power, and 2) charts for level high speed and climb or glide as a function of the appropriate parameters.

The charts are considered to be correct with engineering accuracy (plus or minus five per cent) for the configurations for which they are plotted. Two ranges of blade drag coefficient are considered, corresponding to typical two-blade and three-blade single-rotor configuration. Correction factors for multi-rotor configurations are discussed.

The methods and results of this dissertation are consistent with current design practice, and the charts here developed are shown by illustrative examples to facilitate the repeated trials and compromises necessary in evolving an economical helicopter design. 97 pages. $1.21. MicA 55-1028

supported-nickel catalyst. These cylinders were short enough to act as differential reactors. Wall thicknesses varied from 1/32 inch to 1/4 inch. The gaseous reactants passed through the hollow cylinders and diffused radially into the walls, where the reaction actually occurred.

A differential equation was derived describing the diffusion and reaction processes within a porous catalyst cylinder. This equation was derived from material balances on a differential element of catalyst. The assumption was made that pressure was constant within the catalyst pores.

The hydrogenation of ethylene was found to be first order with respect to ethylene for the supported-nickel catalyst used, with temperatures varying from 130-230°F. and hydrogen in excess.

The differential equation was solved for several specific reaction runs, but it was found impossible to verify the boundary conditions. It was concluded that a complete solution of the equation for a wide range of variables must be obtained to ascertain whether or not the equation actually describes the physical conditions within the catalyst.

An empirical correlation was obtained which describes the experimental data to plus or minus ten per cent. This correlation has the form of a graph in which the effectiveness factor is plotted as a function of a dimensionless modulus. The effectiveness factor is the ratio of reaction rate with a given catalyst grain size to the reaction rate possible with a totally accessible catalyst. The dimensionless modulus is defined by the equation:

$$M = \frac{x\sqrt{A}}{|C_0|\,0.15}$$

Where:

x = wall thickness of catalyst tube.
A = a constant for the catalyst at a specific temperature containing the intrinsic rate coefficient.
$|C_0|$ = the absolute value of a constant determined from reactant gas composition.

The true activation energy of the catalyst surface was 9.7 kcal. per g-mole. This decreased to 7.0 kcal. per g-mole for a reaction catalyzed by a thick-walled tube where diffusion of the reactants through the pores was rate controlling.

212 pages. $2.65. MicA 55-1029

ENGINEERING, CHEMICAL

DIFFUSION AND CHEMICAL REACTION IN POROUS CATALYSTS

(Publication No. 11,396)

Clement White Bowen, Jr., Ph.D.
University of Pennsylvania, 1955

Supervisor: P. F. Hagerty

Rates of reaction for the hydrogenation of ethylene were obtained using hollow cylinders of a

FACTORS AFFECTING THE UNIFORMITY OF FLUIDIZATION IN FLUIDIZED BEDS

(Publication No. 11,674)

Llewellyn Francis Brennecke, Sc.D.
Washington University, 1955

Chairman: Aaron Rose

This investigation was undertaken to determine the effects of six variables upon the uniformity of

fluidization in a fluidized bed. These variables were (1) bed height, H, inches, (2) fluid velocity, V, feet per second, (3) bed diameter, D, inches, (4) probe position, P, inches from the bottom of the bed, (5) particle diameter, d, microns, and (6) particle density, ρ, grams per cubic centimeter.

The uniformity of fluidization was measured with a very sensitive differential pressure cell and fast acting recorder. The pressure drop fluctuations observed across a fluidized bed permitted a uniformity index to be calculated. This index was correlated on a statistical basis with the above variables and has the following form:

$$U = -1182.1 - 3.3\,D + 1.4\,P + 13.V + 0.03\,P^2 + 417.\rho - 38.\rho^2 + 820.\,1/\rho^{0.826} + 0.03\,d - 8.4 \times 10^{-5} \times d^2 - 0.05\,HP - 5.\epsilon_0$$

ϵ_0 is the void fraction of the settled bed measured under conditions described in this investigation.

171 pages. $2.14. MicA 55-1030

STUDIES OF THE SEPARATION OF TITANIUM AND IRON SULFATES BY SOLVENT EXTRACTION

(Publication No. 11,397)

Edgar Nixon Brightbill, Ph.D.
University of Pennsylvania, 1955

Supervisor: A. N. Hixson

A broad review of the subject of liquid-liquid extraction of metal salts from aqueous solution with organic solvents is presented in which a distinction is made between inorganic and organometallic extractions. Included is a summary of the available references to mass transfer data for such systems.

In a section on theoretical considerations the distinction between the two classes of metal salt extraction is amplified and attention is focused on the inorganic type as the most important from the standpoint of possible commercial exploitation. A discussion of the significance of the distribution coefficient is included in this section. A summary of the more important observations regarding the nature of solvent extraction of metal salts is also included.

Following a review of previous work by the author on this system, some preliminary studies are described. The results of these studies lead to the selection of n-amyl alcohol as the solvent to be studied in detail.

Equilibrium distribution studies for the systems H_2SO_4 - water - n-amyl alcohol - X, where X is $TiOSO_4$, $Fe_2(SO_4)_3$, and $TiOSO_4 + Fe_2(SO_4)_3$ are reported in terms of the metal and acid distribution coefficients and also as weight fraction equilibrium tie-line data. A system of simultaneous material balances permitted calculation of the data in this latter form. Over the range of acid concentrations from 1.5 to 6.5 M and total metal salt concentrations from 0.07 to 0.24 M an approximately constant separation factor between titanium and iron of 1.6 was obtained. Distribution coefficients for titanyl sulfate varied from 0 to 0.5 and for ferric sulfate from 0 to 0.3 over this same range. The variation of distribution coefficient with acid concentration was discussed in light of several possible interpretations, one of which was applied to this system. Briefly, this interpretation relates the degree of extraction to the effective dielectric constant of the extract phase, the latter value being a function of the water and acid content of the extract phase. Equilibrium distribution studies of various acids between their aqueous solutions and n-amyl alcohol were also carried out in order to throw some light on the mechanisms involved. These are also reported in terms of distribution coefficients and weight fraction equilibrium tie-line data. Interpretation of these results agrees with some generalizations suggested in the section on theoretical considerations.

In order to use the simultaneous material balances to calculate complete composition data for each phase, it was necessary to estimate the solubility of alcohol in the raffinate phase. To assist in this, solubility studies in various strength acid solutions were conducted and the smoothed data presented in graphical form with temperature as the parameter.

The effect of solvent structure of a closely related group of monohydroxy alcohols was briefly examined and interpreted in light of the mechanism assumed to apply to the extraction. The possibility of reaction of the solvent with the metal salt or with acid is discussed, and some experimental observations noted which imply a slight reaction with acid depending on the severity of the contact.

A comparison of the present data is made, so far as possible, with data disclosed in the patent literature. Recommendations for future study are also included. 198 pages. $2.48. MicA 55-1031

THE EFFECT OF OPERATING VARIABLES ON SPRAYS PRODUCED BY A PRESSURE-TYPE NOZZLE

(Publication No. 7628)

Joseph Anthony Consiglio, Ph.D.
University of Michigan, 1954

The purpose of this investigation was to determine the effect of liquid physical properties and volume flow rate on the surface area of sprays produced by a pressure-type atomizing nozzle. The internal construction of the nozzle is of the grooved-core type in which the liquid is admitted tangentially to the swirl-chamber and then flows out of the nozzle orifice.

The method employed to determine the drop-size distribution of the sprays is based on the light-scattering properties of the drops and is basically an optical sampling technique. The experimental equipment consists of a spray chamber 3 feet square by 10 feet high, and a pump unit capable of delivering measured volumes of liquid to the nozzle at maximum rate

of 32 cubic centimeters per second at pressures up to 3000 pounds per square inch. A light source and light detector are mounted outside of the chamber on opposite walls. The parallel, monochromatic light beam from the source travels through windows in the walls of the chamber and is focused on the phototube in the light detector. The intensity of the light beam reaching the phototube is measured and continuously recorded by means of an amplifier, and recorder system.

The experimental procedure consists of spraying a known volume of liquid upwards into the chamber which has been previously saturated. The intensity of the light beam transmitted through the dispersion of spray drops is measured continuously as the drops undergo differential settling through a distance of 279 centimeters. The number and size of drops up to a diameter of 40 microns in diameter are calculated from the original light intensity data by means of a modified form of the Lambert-Beer transmission equation and the Stokes' Law equation. For each liquid and spray condition a series of light transmission runs are made by varing the volume sprayed. For the same conditions the amount of liquid that settles out of the system during the spray period is measured for varying volumes sprayed. The latter measurements provide the basis for an empirical procedure to correct the calculated values of the surface areas for changes in drop-size distribution that occur during the spray and settling periods. The surface area of drops greater than 40 microns in diameter is estimated by an empirical distribution equation.

The range of the variables investigated is surface tension from 28 to 70 dynes per centimeter, density from 0.8 to 1.1 gram per cubic centimeter, viscosity from 1 to 45 centipoise, and volume flow rate from 1.5 to 3.1 cubic centimeters per second. The specific surface area of the sprays is correlated by an equation of two dimensionless groups in terms of the variables which indicates that the specific surface area is a function of the surface tension to the -1.0 power, the kinematic viscosity to the -0.4 power, and the volume flow rate to the 2.4 power. The conversion of potential energy in the liquid, due to it being under pressure, to surface area energy per unit mass of liquid appears to be constant at approximately 0.1 percent. The volume flow rate is correlated by an equation of two dimensionless groups which indicates that the volume flow rate is a function of the viscosity to the 0.17 power, the density to -0.58 power, and the spray pressure to 0.42 power.

The quantitative effects of the variables on the specific surface area of the spray as determined from the correlation are in accord with the qualitative effects deduced from theoretical considerations. The value of the exponent on volume flow rate for surface area correlation appears to increase with an increase in the intensity of the shear forces developed in the liquid as it flows through the swirl-chamber.

165 pages. $2.06. MicA 55-1032

THERMAL DIFFUSION IN AQUEOUS SOLUTIONS UNDER PRESSURE

(Publication No. 11,495)

Dario Ricardo Cova, Ph.D.
University of Illinois, 1955

When a mixture is subjected to a temperature gradient, there occurs a gradient in concentration. This phenomenon is thermal diffusion.

The thermal diffusion ratio, α, is defined in the flux equation for a binary mixture:

$$\vec{J_i} = - \rho D \left[\overrightarrow{\text{grad}}\, X_i - \frac{\alpha X_i (1 - X_i)}{T} \overrightarrow{\text{grad}}\, T\right]$$

where D is the diffusion coefficient, X, is the mole fraction of component 1, ρ is density, and T is temperature.

The thermal diffusion ratio was determined for binary mixtures of hydrogen-bonding liquids under pressures extending to 10,000 atmospheres. The following mixtures were investigated: 20, 50, and 80 mole per cent ethyl alcohol mixtures in water, 20 mole per cent n-propyl alcohol in water, 20 mole per cent iso-propyl alcohol in water, 20, 50, and 80 mole per cent n-butyl alcohol in ethyl alcohol, and 50 mole per cent iso-butyl alcohol in ethyl alcohol.

It was found that the thermal diffusion ratio was a function of the energies of activation for viscous flow and a steric factor. The steric factor is a measure of the relative sizes of the diffusing units of the components. For hydrogen-bonding liquids this factor can be related to the degree of association in the liquids. It was found that water and the alcohols dissociate under pressure, and that water is much more associated than the alcohols. Under a pressure of 8000 atmospheres all the alcohols are completely dissociated. At 10,000 atmospheres, however, water is still considerably associated.

Thermal diffusion ratios were determined at atmospheric pressure for electrolytes dissolved in water over a concentration range extending from 0.01 normal to 1.0 normal. The following electrolytes were investigated: sodium chloride, lithium chloride, cesium chloride, cesium nitrate, magnesium chloride, and sodium iodide.

It was found that the effect of concentration on the thermal diffusion ratio for electrolytes was predicted by the energies of activation for diffusion. For this range of concentration the steric factor was constant for any one electrolyte. It was concluded that the degree of hydration of the ions is constant over this range of concentration. The size of the diffusing unit of the cation was found to decrease as the ionic radius increased. The data indicated the possibility that anions as well as cations were hydrated. The average size of the diffusing unit of the ions was found to be approximately equal to the size of the diffusing unit of water.

A two-chambered cell was used in the investigation. The contents of each chamber were mixed by magnetic stirrers. The chambers were separated by a fritted glass disc through which the diffusion occurred. During an experiment, a temperature

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difference of approximately 12° C. was maintained between the chambers, until the steady-state concentration difference had been attained. The non-electrolytic solutions were analyzed for concentration by a refractometer method. The concentrations of the electrolytes were found through a Volhard titration for the halide ion. The concentration analysis of cesium nitrate was carried out by a weighing technique. 113 pages. $1.41. MicA 55-1033

THE EFFECT OF PRESSURE ON SOLUBILITY

(Publication No. 11,500)

Elliott Porter Doane, Ph.D.
University of Illinois, 1955

Experimental values of the solubility under pressure have been obtained for the following systems at 25 degrees C.: phenanthrene, SnI_4, and C_2Cl_6 in hexane, heptane, octane, and CS_2; anthracene in CS_2; and C_2Cl_6 in 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane, and 2,3-dimethylbutane. The maximum pressure was ordinarily from 7000 to 10,000 atmospheres. In all the systems studied the solubility plotted as mole fraction solid decreases with increasing pressure. When the log of the ratio of the mole fraction of solid under pressure to that at one atmosphere is plotted versus pressure, the resulting curve is often roughly linear. In a typical case the ratio decreases tenfold in 5000 atmospheres.

The cell used to determine the solubility consisted of two chambers, the upper and the lower, which were separated by a piece of filter paper. Solid was placed in the lower chamber only, and the filter paper prevented the entry of solid particles into the upper chamber. Stirring was accomplished magnetically with a small solenoid which moved iron stirrers inside both the chambers. Excessive contact between liquid and solid while loading the cell, which might have brought the concentration to a level above saturation under pressure, was prevented by an amalgamated tinfoil cap placed over the solid. After pressure was applied, the action of the stirrer was sufficient to disintegrate the foil. The solutions were usually stirred for about 20 hours. Then pressure was released, and a sample was withdrawn from the upper chamber. Proof of the attainment of equilibrium was provided by the constancy of the results obtained for runs in which the initial concentration of the solutions placed in the cell differed.

The results were analyzed in terms of the Scatchard-Hildebrand theory of solutions, which is based on a model of molecules with spherically symmetrical potential fields. In this theory the criterion for solubility is the "solubility parameter," which is the square root of a cohesive energy per unit volume. Values of the solubility parameters of the solvents calculated from P-V-T data were used in conjunction with the solubility data to obtain the solubility parameters of the solutes. Then the deviations of the various systems from the assumed model were determined. The phenanthrene-N-paraffin systems obey the theoretical picture closely at all pressures, while the SnI_4 and C_2Cl_6 systems with the same solvents show large deviations even at fairly low pressures. This is attributed to the greater disruption of the hydrocarbon orientation caused by the large, nearly spherical, molecules of SnI_4 and C_2Cl_6. The deviations for C_2Cl_6 in the hexane isomers are not large until a pressure of about 7000 atmospheres is reached; then large deviations occur. It can be concluded that in all the SnI_4 and C_2Cl_6 systems high pressure causes less strict adherence to the simple theoretical model. 142 pages. $1.78. MicA 55-1034

ISOMERIC EFFECTS IN THERMAL DIFFUSION

(Publication No. 11,501)

Elmer Lloyd Dougherty, Jr., Ph.D.
University of Illinois, 1955

Thermal diffusion is the mass flux which occurs in any mixture as a result of a heat flux and which ultimately gives rise to a concentration gradient. Consequently, the flux equation for a binary mixture is written:

$$\vec{J}_1 = -\rho D[\overrightarrow{\text{grad}}\, x_1 - \frac{\alpha x_1 x_2}{T} \overrightarrow{\text{grad}}\, T] \qquad (1)$$

where $\vec{J}_1$ = flux of mass, D = diffusion coefficient, x_i = mol fraction i, T = absolute temperature and ρ = density. This equation defines the thermal diffusion ratio, α.

By compiling accurate experimental data, it was hoped to arrive at a quantitative description of thermal diffusion. An apparatus, consisting of a cell divided into two chambers by a fritted glass disc across which a temperature gradient was maintained, was developed in this laboratory for measuring thermal diffusion at atmospheric pressure and at high pressures (100-10,000 atm.). Stirring was provided in each chamber, and temperatures were measured by thermocouples immersed in the liquid. Runs were made until the steady-state was attained. By determining the refractive index of samples from each chamber, information was obtained for calculating the thermal diffusion ratio:

$$\alpha = \ln \left(\frac{x_1}{x_2}\right)_H \left(\frac{x_2}{x_1}\right)_C \Big/ \ln \left(\frac{T_H}{T_C}\right) \qquad (2)$$

where the obvious notation for the hot and cold chamber has been used.

Intermolecular potential and molecular structure are two factors which play an important role in determining the magnitude and direction of the separation. One means of determining the effect of these parameters is by using high pressures; another is to study systems of isomers. In order to magnify the separations, binary mixtures of various isomers with carbon disulfide were studied and the results

compared. The isomeric systems studied at atmospheric pressure (6°C) were: (1) cis- and trans-dichloroethylene, (2) 1,1- and 1,2-dichloroethane, (3) n-hexane, 2- and 3-methylpentane, and 2,2- and 2,3-dimethylbutane, (4) n-, sec-, iso and tertiary butyl chloride, (5) o-, m-, p-xylene and ethylbenzene, and (6) n-, sec- and iso-butyl alcohol. The first four isomeric sets were also studied at high pressures (40°C).

The kinetic theories of thermal diffusion and the physical interpretation given to the activation energy for molecular motion are shown to be unsatisfactory. A satisfactory theory of thermal diffusion based upon the results of the thermodynamics of irreversible processes is presented. The net heat of transport is interpreted in terms of the activation energy necessary for molecular motion. The expression obtained for α shows the "activation energy density" to be the controlling factor in thermal diffusion:

$$\alpha = \frac{M_1\bar{V}_2 + M_2\bar{V}_1}{2\bar{M}\, x_1 \partial\mu_1/\partial x_1}\left\{\frac{\Delta\bar{U}_2^{\neq}}{\bar{V}_2} - \frac{\Delta\bar{U}_1^{\neq}}{\bar{V}_1}\right\} \qquad (3)$$

where $\bar{V}_i$ = partial molal volume of i, $\Delta\bar{U}_i^{\neq}$ = partial molal activation energy of i, M_i = molecular weight of i and $\bar{M}$ = average molecular weight and μ_i = chemical potential of i.

In applying this expression it was necessary to substitute the properties of the pure components for partial molal quantities and to assume $x_1 \partial\mu_1/\partial x_1 = RT$. Activation energies were calculated from viscosity data. Such data were available for all of the isomeric systems at atmospheric pressure, but for only n-hexane at higher pressures. The high pressure results obtained in another investigation for binary solutions of n-octane, carbon tetrachloride, n-butyl bromide, chlorobenzene, bromobenzene, and ethyl iodide in carbon disulfide are compared to theory. Excellent agreement between theory, (3), and experiment, (2), is obtained for solutions of "normal" liquids. Experimentally it is found that the component with the higher activation energy density is enriched in the cold chamber. Among the members of an isomeric set the more nearly round the molecule, the higher the activation energy and, consequently, the stronger the tendency to become enriched in the cold chamber. The theory fails to hold for systems in which one component is hydrogen-bonding; a modification of the theory for such systems is proposed.

223 pages. $2.79. MicA 55-1035

I. DIFFUSION IN POLYMER SOLUTIONS UNDER PRESSURE. II. THERMAL DIFFUSION IN POLYMER SOLUTIONS.

(Publication No. 11,503)

Alden Hayes Emery, Jr., Ph.D.
University of Illinois, 1955

I. Diffusion in Polymer Solutions under Pressure

Diffusion coefficients of solutions of two molecular weight fractions of a polymer formed by the oxidative polymerization of 1,6-hexanedithiol were measured at pressures up to 6,400 atmospheres by means of a tracer technique, using radioactive sulfur incorporated in the polymer structure. Measurements were made at two temperatures, 25° C. and 50° C., and at polymer concentrations of one and five weight percent, both in toluene, and, in addition, some values were obtained using chloroform as a solvent.

In general, as the pressure is increased, the diffusion coefficient at first increases, reaches a maximum at about 500 to 1,000 atmospheres pressure, and then decreases with further increase in pressure, rapidly at first and then more slowly. The portions of the curves at pressures higher than that at which the maximum occurs resemble isotherms of materials of ordinary molecular weight, whereas the initial portions of the curves are somewhat unusual in that the diffusion coefficient rises with increasing pressure.

II. Thermal Diffusion in Polymer Solutions

Thermal diffusion ratios of several molecular weights of polystyrene dissolved in a number of solvents have been measured in an open-column cell designed to avoid thermal convection. The molecular weights of polystyrene used varied from 10,000 to 338,000, and the solvents used were toluene, o-xylene, ethyl benzene, styrene, dioxane, and pyridine.

The thermal diffusion ratios were found to be rather sharp functions of concentration, decreasing from values over 200 at concentrations of a few tenths of a percent to about twenty at about three volume percent. The thermal diffusion ratios were largest for the highest molecular weight polymer and varied smoothly with molecular weight. However, this effect of molecular weight was greatest at the lowest concentrations and disappeared altogether at about three volume percent, at which concentration all molecular weights exhibited values of about twenty.

Following a lead by Flory, an equation with no arbitrary constants has been derived for the thermodynamic properties of polymer solutions in the low concentration range which, when inserted into Drickamer's development of de Groot's expression for the thermal diffusion ratio, gives an equation with one arbitrary constant which follows the concentration dependence of the data as closely as the accuracy of the data permits. The one arbitrary constant is the number of chain carbon atoms in a diffusing segment, and this number has been calculated from the data to be in the range 10 to 13, depending on the solvent. The value is affected only slightly by changes in molecular weight in the range studied. The range of values calculated is about half that predicted by Eyring by extrapolation of his data on viscosity of pure hydrocarbons, and there is reason to believe that this should be so, that the number of chain atoms in a diffusing segment in solution is about half that in the case of pure polymer.

225 pages. $2.81. MicA 55-1036

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A STUDY OF THE THERMAL AND PHYSICAL PROPERTIES AND HEAT TRANSFER COEFFICIENTS OF SULPHATE PAPER MILL BLACK LIQUOR

(Publication No. 11,473)

Richard L. Harvin, Ph.D.
The University of Florida, 1955

A thorough study is presented concerning transfer of heat from a tube wall to a stream of moving sulphate black liquor, the determination of the physical properties pertaining thereto, the calculation of the film heat transfer coefficients prevailing at various conditions and the interrelation of said physical properties and film coefficients.

Specific heat, thermal conductivity, viscosity and specific gravity were determined as functions of both temperature and per cent solids over the ranges of 100 to 200° F. and 0 to 60%, respectively. The specific heat data were found to be in general agreement with some of the more recent data in the literature, but the data presented are more complete and include temperature as a parameter.

No data were found in the literature on thermal conductivity of black liquor. The data presented were determined using a specially developed apparatus which is considered to be usable for many aqueous solutions or relatively nonvolatile liquids. This apparatus yields thermal conductivity values relative to a standard material (water) and involves the transfer of heat vertically downward through a liquid layer one-third of an inch thick.

The viscosity was evaluated using an Ostwald type viscometer. The results were found to yield straight lines when plotted on a modified Othmer diagram (logarithm of viscosity versus logarithm of viscosity of a reference material). The results also indicated that the black liquor behaved as a Newtonian liquor over the range studied.

A single tube heat exchanger was used for the evaluation of the heat transfer coefficients. The heat exchange tube was made of 0.51 inch inside diameter stainless steel seamless tubing and was heated over a length of six feet. An additional 1.5 feet was used as a calming section at the inlet. The inside tube surface temperature was evaluated from the heat flow and the temperatures indicated by eight thermocouples imbedded in the tube wall.

The heat transfer coefficients were evaluated using fluids of various concentrations ranging from pure water to approximately 50% black liquid solids. The flow rate and temperatures were varied so as to obtain the maximum possible range of Reynolds number values with each concentration. The range of Reynolds numbers thus produced was from 100 to 80000.

In general, the calculated j factors were found to be in agreement with the Sieder and Tate equations for turbulent and viscous heat transfer.

Turbulent:

$$j' = \left(\frac{h}{CpG}\right)\left(\frac{Cp\mu}{k}\right)^{0.667}\left(\frac{\mu_s}{\mu}\right)^{0.14} = 0.027\left(\frac{DG}{\mu}\right)^{-0.2}$$

Viscous:

$$j' = \left(\frac{h}{CpG}\right)\left(\frac{Cp\mu}{k}\right)^{0.667}\left(\frac{\mu_s}{\mu}\right)^{0.14} = 1.86\left(\frac{DG}{\mu}\right)^{-0.667}\left(\frac{D}{L}\right)^{0.333}$$

Some of the j factors in the viscous region were as much as 100% higher than the predicted values due to natural convection. The Grashof numbers for the viscous runs varied from 186 to 336000. Three published natural convection corrections were evaluated for these data and the Sieder and Tate factor, $\phi = 0.8(1 + 0.010\ Gr^{0.333})$, was found to be more effective than the corrections of Kern and Othmer, and Eubank and Proctor. The differences in effectiveness of these factors were attributed to the L/D variation of the apparatus used by the various investigators. The constants in the Kern and Othmer natural convection factor were reevaluated for these data by the method of least squares and this correction was found to be excellent. It was proposed that further work be done to develop a method of accounting for natural convection equally suitable for all L/D ratios.

154 pages. $1.93. MicA 55-1037

EFFECT OF SOLIDS FLOW RATE AND PARTICLE DIAMETER ON PRESSURE DROP IN PNEUMATIC TRANSPORT SYSTEMS

(Publication No. 11,649)

Nanalal Chandulal Mehta, Ph.D.
Purdue University, 1955

Major Professor: J. M. Smith

Vertical and horizontal transport of scotchlite glass beads have been investigated in a one-half inch standard steel pipe. Air was used as the transport fluid. It was originally planned to carry out the investigation in a one-half inch constant diameter pyrex glass pipe. Because of the electrostatic charges generated by friction between particles and between particles and the pipe wall, the equipment could not be operated to give consistent results. The glass pipe section was therefore abandoned and replaced by steel pipe.

Pressure drop data were obtained for vertical and horizontal transport of 0.036 and 0.097 mm. particles over air velocities of 10-90 feet/sec. Five solids flow rates, 5.90, 12.0, 23.4, 32.5, and 40.2 lbs./sq. ft. sec., were used for the 0.097 mm. particles, and two solids flow rates, 12.0 and 23.4 lbs./sq. ft. sec., were used for the 0.036 mm. particles. Actual solids concentrations for vertical and horizontal transport were determined experimentally for both sizes. The pressure drop data are reproducible within ±15%, and most of the particle velocity data can be reproduced within ±25%. It has been shown that the particle velocity is independent of the solids rate, but is influenced by the carrier gas velocity.

The existing methods of correlation failed to explain the data in a satisfactory manner. A discussion of each of the methods considered is given in the

section on discussion of results. A new method in terms of the mixture friction factor was developed which correlates the data for 0.097 mm. particles within ±15%, and that of 0.036 mm. particles within ±10% for horizontal transport over the entire range of Reynolds number (9,000 - 60,000). The results for vertical transport are not as good. The method satisfactorily explains the data for Reynolds numbers between 25,000 - 60,000. The method of establishing the central line in the lower Reynolds number range has been discussed at length in the section on discussion of results.

The results of this work show that the pressure drop in a pneumatic transport system is a function of the particle flow type. Three particle flow types, bouncing flow, suspension flow, and flow as a true fluid, have been considered. The particle flow type is determined by the physical properties of the particles, carrier fluid, and the pipe diameter. In this work 0.097 mm. particles exhibited bouncing type flow, while 0.036 mm. particles were found to be in suspension type flow. The pressure drop for particles having bouncing flow is greater than that for suspension flow, under the same conditions.

The mixture friction factor method used to correlate the data of this work clearly points out that the particle velocity is an important variable to be considered in explaining the pressure drop data. Further, it shows that for a given pipe and material, the mixture friction factor is independent of the solids rate. The mixture friction factor values for horizontal and vertical transport are approximately equal over the range of the Reynolds number investigated for each of the materials. The mixture friction factor-Reynolds number relationship shown by the correlation is analogous to that of the friction factor chart for homogeneous fluids.

160 pages. $2.00. MicA 55-1038

THE EFFECT OF PARTICLE SIZE, CONCENTRATION, AND TEMPERATURE, ON HEAT TRANSFER TO CLOUDS OF SMALL PARTICLES

(Publication No. 10,818)

Celal M. Oktay, Ph.D.
University of Florida, 1955

A study was made of heat transfer to moving clouds of small particles dropped through still air in a furnace approaching the conditions of two infinite parallel plates. The investigation had two primary purposes:

1. To obtain experimental over-all heat transfer data with clouds of small particles for a parallel plate furnace and to compare them with the data from tubular furnaces.
2. To study the convection heat transfer for particles having a Reynolds number, N_{Re}, less than 50.

The range of particle sizes used was between 193 to 595 microns, the temperature of the wall ranged from 630°F up to 1530°F and the particle concentration was from 200 to 1800 lbs./(hr.)(sq.ft.). The results are compared with those from the only other investigation in this field where more limited sizes of particles and a more limited temperature were used in tubular furnaces. The discrepancies between the experimental results and the theory of Johnstone's work with tubular furnaces are explained. Under certain conditions this parallel plate furnace gave results similar to those from the tube furnace. The principal factors affecting the over-all heat transmission were observed to be: the furnace wall temperature, the feed rate, the particle size and the rate of fall of the particles.

A general equation valid for all feed rates was derived to be used in the calculation of the radiation component of heat transfer h_r for the case of a parallel plate furnace.

Am empirical relationship was obtained for the convection coefficient at the particle surface for particles of sizes 250 to 600 microns in diameter and having a density about 2.65. For particles larger than 600 microns the experimental curve values are still in agreement with the theory. The heat transfer factor, N_{St}, for the experimental results is expressed in an empirical equation which should be used only for the particle size range covered in this investigation.

This equation seems to follow the same trend that has been found in the data of other investigators, as well as in the theoretical relationships even in the region of Reynolds numbers greater than 50, which is outside the scope of this paper.

150 pages. $1.88. MicA 55-1039

KINETICS OF THE HOMOGENEOUS LIQUID-PHASE REACTION BETWEEN PROPYLENE OXIDE AND METHYL ALCOHOL CATALYZED BY SODIUM HYDROXIDE

(Publication No. 11,337)

Hector Andrew Pecorini, Ph.D.
University of Michigan, 1954

The purpose of this investigation was to determine and correlate the effect of temperature, sodium hydroxide catalyst concentration, and initial reactant quantities upon the rates of the homogeneous liquid-phase reactions between methanol and propylene oxide to form 1-methoxy-2-propanol, and between 1-methoxy-2-propanol and propylene oxide to form methoxy dipropylene glycol

$$[CH_3OCH_2CH(CH_3)OCH_2CH(CH_3)OH],$$

both when these reactions occurred individually and when they occurred consecutively.

The reactions were conducted in batch reactors. Data were obtained during each run by removing small samples at noted time intervals, and analyzing them for unreacted propylene oxide, either by titration or by refractive index methods. In some runs a

complete analysis of the reaction mixture was also made by fractional distillation. Excess alcohol (five moles per mole of propylene oxide) was employed in most runs in order to confine the reactions to only one of those possible in the homologous series of reactions.

Rate constants were calculated for the methanol-propylene oxide and methoxy propanol-propylene oxide reactions from the high mole ratio data at a single temperature and catalyst level, using a number of postulated rate equations. The applicability of these equations were tested by comparing propylene oxide composition-time curves calculated from them using the previously derived rate constants with experimental points from other runs at the same temperature, catalyst concentration, and initial equimolal mole ratio, in which both reactions occurred consecutively. One set of rate equations was found applicable for the different experimental conditions investigated.

These rate equations were used to calculate reaction rate constants for both reactions from the five to one mole ratio data obtained in the temperature range of 35°C to 100°C and in the sodium hydroxide catalyst range of 0.03 to 1.5 weight percent (catalyst-free basis). The rate constants were linear functions of the sodium hydroxide concentration, and their temperature dependence followed the Arrhenius equation. All the variables studied were then included in the rate equations by expressing the rate constants as functions of initial catalyst concentration and temperature.

For methanol plus propylene oxide the rate equation was:

$$dx/d\theta = 3.24\,(10)^{13}\, e^{-17,800/RT}\, (NaOH)_o(aH)(b)/n_t$$

For 1-methoxy-2-propanol plus propylene oxide the rate equation was:

$$dy/d\theta = 3.15\,(10)^{10}\, e^{-14,600/RT}\, (NaOH)_o(abH)(b)/n_t$$

where:

- (aH) = Methanol, gram moles per 100 grams of initial charge
- (abH) = 1-methoxy-2-propanol, moles per 100 grams
- (b) = Propylene oxide, moles per 100 grams
- n_t = Total number of moles present per 100 grams
- $(NaOH)_o$ = Initial catalyst concentration, moles per 100 grams
- R = Gas constant, 1.987 calories per gram mole
- T = Temperature, °K
- x = Propylene oxide reacted to form methoxy propanol, moles per 100 grams
- y = Propylene oxide reacted to form methoxy dipropylene glycol, moles per 100 grams
- θ = Time, hours.

For the uncatalyzed reaction between methanol and propylene oxide over a temperature range of 45°C to 145°C the rate equation obtained was:

$$dx/d\theta = 2.52\,(10)^{8}\, e^{-16,900/RT}\, (aH)(b)/n_t$$

A comparison of these results with those available in the literature for similar reactions has also been made. 208 pages. $2.60. MicA 55-1040

LIQUID PHASE ADSORPTION EQUILIBRIA FOR THE BENZENE-CYCLOHEXANE-SILICA GEL SYSTEM

(Publication No. 11,608)

Edward Bernard Stuart, Ph.D.
University of Pittsburgh, 1955

This work is an investigation of the effect of temperature and surface configuration on the preferential adsorption of benzene from a benzene-cyclohexane liquid binary solution.

Samples of silica gel were wetted with the solution and the change in concentration of the excess liquid was used to calculate the amount of benzene preferentially adsorbed. Calling the liquid in the pores, the adsorbed phase, the mol fraction of benzene in the adsorbed phase is reported as a function of the liquid phase concentration.

The experimental data were taken at three temperatures, 33°C., 52.6°C., and 77°C. using three different silica gels with two average pore diameters, and covering the complete concentration range of a benzene-cyclohexane binary solution.

A correlating equation is presented and checked with supplementary data from the literature. The literature data that were used in testing the final theory included four isotherms ranging from 23.9°C. to 99°C.; two additional silica gels and a silica-alumina gel; and the toluene-iso-octane binary solution.

The correlating equation is,

$$\left(\frac{y}{1-y}\right) = e^{\frac{\xi k}{T}} \left(\frac{x}{1-x}\right)^{\left(1 - \frac{\Psi}{T}\right)}$$

where y and x are the mol fractions of more strongly adsorbed component in the adsorbed phase and liquid phase respectively, T is the absolute temperature, and k, ξ, and Ψ are constants for the system.

The average deviations of experimental concentrations from concentrations calculated using the correlating equation were 3.2 per cent for the benzene-cyclohexane system, and 7.0 per cent for the toluene-iso octane system.

112 pages. $1.40. MicA 55-1041

TWO- AND THREE-DIMENSIONAL FLOW OF AIR THROUGH SQUARE-EDGED SONIC ORIFICES

(Publication No. 7759)

Alexander Weir, Jr., Ph.D.
University of Michigan, 1954

The validity of square-edged sonic orifices for mass flow measurements has been questioned during

recent years. In this investigation, the flow of air through two-dimensional (rectangular) and three-dimensional (circular) square-edged orifices was examined under pressure ratios of 1.894 to 42 (upstream total pressure/downstream static pressure).

Theoretical considerations indicate that the air upstream of the orifice plate encounters extremely large pressure gradients as it turns the corner of the orifice plate. This results in a zone of low pressure at the inlet to the orifice in the region of the corner and effectively reduces the cross sectional area of the orifice available for flow. The diameter of this effective throat can be expressed as $D \infty 2\triangle$, where D is the static diameter and $\triangle$ is a measure of the decrease on each side of the throat. Supersonic velocity occurs downstream of this "effective throat" before the downstream edge of the orifice plate is reached (1/16 and 1/4 inch thick orifice plates were used).

Schlieren photographs of air flowing under critical conditions through two-dimensional orifices indicated that the above hypothesis was correct. By measurement of the intersection angles of the oblique shock waves, which were initiated at the edge of the low pressure zone, it was possible to determine the Mach number of the flow for the total orifice area, and hence the area of the "effective throat" where sonic velocity occurred. This enabled prediction of the mass flow rate of air through the orifice.

The validity of this prediction was established by mass flow measurements through the orifice based on a primary standard, i.e. the decrease in the mass of air contained in a high pressure (2000 psia) storage system of known volume (170 cu. ft.). Pressure and temperature measurements, together with the Beattie-Bridgeman equation of state, were used to determine the mass of air in the storage system as a function of time.

Mass flow rates ranging from 0.024 to 1.4 lbs air/sec were obtained, with mass velocities as high as 1800 lbs/sec/sq.ft. of orifice area at a pressure ratio of 40. Experiments were performed with eight orifices, four two-dimensional orifices with the distance between the orifice plates (D) increasing from 0.128 to 0.750 inches, and four three-dimensional circular orifices with diameters (D) increasing from 0.122 to 0.390 inches. The results of these experiments indicated that

1. Square-edged sonic orifices can be treated as an ideal nozzle if the diameter of the "effective throat," $D \infty 2\triangle$, is used.
2. The magnitude of $\triangle$ is independent of the pressure ratio between 1.894 and 40, as well as of the absolute value of the upstream pressure.
3. $\triangle$ is independent of orifice diameter for values of D greater than 1/4 inch. Smaller values of $\triangle$ are obtained as D is decreased below this minimum, $\triangle$ approaching 0 as D approaches 0.
4. The mass flow rate through a square-edged sonic orifice is some fraction (A_t/A_E = area of "effective throat"/total area of orifice) of that predicted by one-dimensional flow equations for reversible, adiabatic flow of a perfect gas through an ideal nozzle.

The use of these concepts resolves some of the discrepancies in the literature. Numerical values of $\triangle$ and A_t/A_E are given for both two-dimensional and three-dimensional flow of air as a function of the orifice diameter D. 553 pages. $6.91. MicA 55-1042

ENGINEERING, CIVIL

DYNAMIC PROPERTIES OF STABILIZED SOILS

(Publication No. 11,614)

Mehmet Erdem Ardaman, Ph.D.
Purdue University, 1955

Major Professor: Professor E. J. Yoder

This thesis presents the results of a study dealing with the dynamic properties of four types of soils stabilized with various admixtures. Dynamic tests of fundamental resonant frequency and velocity of compressional wave propagation were made on samples of various sizes. These techniques were confined laboratory testing.

A review of the literature pertaining to soil stabilization by the addition of admixtures of lime, portland cement, fly-ash, and bituminous materials as well as the theory of dynamic testing - including longitudinal, transverse, torsional frequencies and pulse velocity - is presented. Cynamic constants; dynamic modulus of elasticity, dynamic modulus of rigidity, Poisson's ratio are discussed.

It was found that soil and soil-admixture prismatic specimens having dimensions of 1.50″ x 2.00″ x 6.37″ and cylindrical specimens of 2.00″ in diameter by 4.50″ in height responded adequately to dynamic tests, but that larger Proctor-size samples (4.0″ in diameter by 4.5″ in height) were difficult to vibrate at their fundamental frequencies. Due to difficulty in vibrating the cylindrical specimens in torsion, modulus of rigidity and in turn Poisson's ratio were computed only for the prismatic specimens.

For an established moisture-density curve at a constant compactive effort, a relationship was found between resonant frequency, pulse velocity and unconfined compressive strength at corresponding moisture contents when the former were plotted on the ordinate and the moisture on the abscissa. Maximum dynamic values and unconfined compressive strengths occurred, however, at moisture contents less than the optimum of the moisture-density curve.

It was shown that the unconfined compressive strength of a soil sample is a linear function of the pulse velocity squared and/or resonant frequency squared, regardless of the moisture and the density of the sample.

It was found that, at constant moisture content an increase in initial dry density resulted in increased dynamic properties of the mixtures, but the durability of the mixture was not altered appreciably. A sharp decrease in the values of both resonant frequency and

pulse velocity of each sample subjected to weathering tests even before any definite changes in moisture content or density occurred, indicated that the sample was about to fail by cracking or crumbling. Degree of saturation of the samples was found to be governing criterion in their durability. Generally, when the moisture content of the sample reached the optimum its dynamic values and dry density decreased radically, and the sample failed within the following few cycles. This critical degree of saturation was noted to be at or above the optimum moisture content. Thus, it was suggested that field compaction of stabilized soils which will be subjected to weathering should be accomplished at low moisture contents and high densities for maximum durability.

There was a definite relation between transverse resonant frequency and pulse velocity for constant values of Poisson's ratio of the specimens not subjected to durability tests. The relationship between resonant frequency (plotted to an arithmetic scale) and pulse velocity (plotted to an arithmetic scale) was a linear function of Poisson's ratio.

It was indicated that soil-cement, when compared to various other admixtures exhibited the highest dynamic and strength values of the materials tested. At the end of 30 days of moist curing and with 5-percent cement used as an admixture average increases up to 140 percent in dynamic values and 430 percent in computed unconfined compressive strength over the soil sample without admixture were recorded. The combination of 10 percent hydrated lime and 40 percent flyash, in general, gave dynamic values of 105 percent in excess of the soil alone. Addition of 5-percent lime increased the dynamic values 90 percent and the strength 225 percent in a 30-day moist-curing period. On the other hand the soil samples did not show increases in their dynamic and strength characteristics when incorporated with liquid bituminous material (SC-1) under the type of laboratory procedure used.

The changes in pulse velocity squared were found to be direct indications of the relative changes in unconfined compressive strengths of stabilized soil samples subjected to freezing-and-thawing.

It was concluded that the dynamic test techniques of resonant frequency and pulse velocity employed in the investigation were quite satisfactory as a laboratory means of evaluation of stabilized soil samples subjected to moist curing and/or durability tests. Some of the important merits of dynamic testing were found to be consistency and reproducibility of results and elimination of operator error. It was concluded that changes in resonant frequency and pulse velocity were highly indicative of changes in quality of the samples tested. It was further concluded that no apparent correlation existed between the dynamic (non-destructive) and standard brushing (abrasion) test procedures. 173 pages. $2.16. MicA 55-1043

ENGINEERING PROPERTIES OF THE PLEISTOCENE AND RECENT SEDIMENTS OF THE SAN JUAN BAY AREA, PUERTO RICO

(Publication No. 11,498)

Don Uel Deere, Ph.D.
University of Illinois, 1955

The engineering properties of the various genetic types of sediments occurring in the San Juan Bay area, San Juan, Puerto Rico, are discussed in detail. Emphasis is given to the importance which geological factors have had in influencing these engineering properties. The physical features and the general geology of the island of Puerto Rico are described and form a background for the more detailed discussion of the Pleistocene and Recent sediments of the San Juan Bay area. Topics include the mode of origin of the sediments, their areal and vertical extent, their source, their probable geological age, and subsequent geological events which have modified the physical properties of the materials contained in the sedimentary deposits. Boring logs, cross-sections, and geological maps supplement the written discussion.

A geological map of the San Juan Metropolitan Area is presented. The outcrop areas of the Cretaceous and Tertiary rocks are given as well as the distribution of the Pleistocene and Recent sediments. The various sedimentary units shown include old alluvium (Hato Rey formation), eolian quartz sand (Santurce sand), partially cemented eolian quartz and calcareous sand (San Juan formation), floodplain sediments, lagoonal sediments, and sand-covered lagoonal sediments. The age of the sediments ranges from early Pleistocene (?) to the present. Many of the sedimentary deposits are shown to be genetically connected with the rise and fall of sea level associated with the Wisconsin stage of glaciation.

The significant engineering properties of sediments in general are discussed. These include water content, Atterberg limits, activity ratio, shearing resistance, compressibility, secondary structure, relative density, effective diameter, uniformity coefficient, and natural unit weight. The values of these engineering properties are given for each of the genetic types of sedimentary units. The shearing resistance and compressibility of the floodplain sediments and lagoonal sediments in particular are treated in detail. Results of laboratory test, large-scale field tests, and observations of the behaviour of fills and structures built over the compressible lagoonal sediments are given. The distribution and thickness of the compressible lagoonal sediments (including both the mineral and organic sediments) occurring in the San Juan Bay area are given, as well as the distribution and thickness of the wholly peat portions of the lagoonal sediments. A water content profile is shown for a typical site in the lagoonal area in which the great variation in the natural water content (from 50 to 500 per cent) of the lagoonal sediments can be seen. The natural water content is shown to be an important engineering property of lagoonal sediments and statistical relationships of the

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

water content with the natural unit weight, the compression index, and the compression ratio are given.

Typical foundation problems associated with each type of sedimentary deposit are discussed. The problems include determination of the shearing resistance of the sediments for the design of spread footing foundations and skin-friction piles, the magnitude and rate of settlement of structures or fills built over compressible sediments, the presence and extent of compressible lagoonal sediments buried beneath sand beaches or dunes, the amount of pre-loading of the floodplain sediments, and the depth and character of the Tertiary bedrock in the areas where piles are used. 155 pages. $1.94. MicA 55-1044

AN EVALUATION OF CERTAIN LIMITED ACCESS HIGHWAYS

(Publication No. 11,646)

Adolf Darlington May, Jr., Ph.D.
Purdue University, 1955

Major Professor: K. B. Woods

This study includes an inventory of limited access highways, a summary of the laws applicable to limited access highways, a field investigation to compare travel time, operating costs, and highway safety on certain controlled and uncontrolled access highways, a determination of additional costs assignable to the control of access to highways, and a comparison of the permanence of operating characteristics on controlled and uncontrolled access highways.

An inventory of the mileage of publicly operated controlled access highways is presented by state, length of service, how designated, type of control, and geometric design. In addition a summary of the important features of the limited access laws in the various states is presented, as well as the dates of adoptions and revisions.

The field investigation was designed to determine the effect of access control on vehicle operating characteristics. The case study approach was used and each case study included two sections of highways having similar characteristics with the exception of access control. A test vehicle equipped with special recording apparatus was used to make a number of runs of each section to ascertain the travel time, operating costs, and safety for the two routes. Twelve case studies were selected and included such variables as extent of access control, degree of urbanization, topography, and geographical location.

Approximate additional cost of controlled access highways was obtained from the various states for completely and partially controlled access highways in urban, suburban, and rural areas. Approximate cost data are presented when the access is controlled by the construction of service roads and by the purchase of access rights.

The permanence of the operating characteristics on controlled and uncontrolled access highways is discussed from the point of view of travel time, highway safety, and the protection of the initial investment of the highway.

The results of the study indicated that there were 39 states which had limited access laws and that there was a total of 5420.7 miles of publicly owned limited access highways as reported by the states in the early part of 1954. The comparison of the operating characteristics of the selected controlled and uncontrolled access highways showed that access control was beneficial to the highway user. A savings in travel time, a reduction of operating costs in urban areas, and a reduction of accidents and fatalities were the major benefits to the highway user by access control. In addition to the benefits to the highway user directly, the operating characteristics of limited access highways are more permanent than those on nonlimited access highways which results in a more economical highway facility. 213 pages. $2.66. MicA 55-1045

ENGINEERING, ELECTRICAL

TRANSMISSION LOSSES IN INTEGRATED POWER TRANSMISSION SYSTEMS

(Publication No. 11,863)

Charles Robert Cahn, Ph.D.
Syracuse University, 1955

It is the purpose of this work to study in detail several practical methods, including two new ones developed by the author, of considering transmission losses in electric power systems. The accuracy, computational difficulty, and amount of network analyzer time needed for each method are of particular interest. Certain approximations concerning the behavior of the power system are required of any given method, and the effects of these are considered both theoretically and by numerical studies of reasonably representative power systems.

The Kirchmayer-Kron total loss formula is shown to give generally satisfactory results in predicting the transmission losses in practical systems. The required numerical calculations and network analyzer measurements are considerable, especially when many small generating stations and many loads are present. The Kirchmayer-Glimn incremental loss formula, while more easily obtained than the Kirchmayer-Kron total loss formula, appears to be of unsatisfactory accuracy. Other published methods of obtaining a total loss formula either require more computations than the Kirchmayer-Kron method or are of unsatisfactory accuracy.

Remarkably simple formulas for predicting incremental losses have been obtained by Brownlee. These formulas require knowledge of the generating station bus voltage phase angles and, therefore, are not applicable to present power systems without the use of additional, highly accurate telemetering equipment. An accomplishment of this work is a general

proof of the applicability of the Brownlee formulas to those practical power systems which do not have widely varying R/X ratios of the transmission lines. Using the Brownlee formulas, an excellent agreement with the actual losses is obtained for the numerical systems studied.

It is also shown that the Brownlee formulas can serve as the starting point in the derivation of conventional incremental and total loss formulas, which do not require voltage phase angle information. The new methods require less computations and network analyzer measurements than any previous ways of obtaining conventional loss formulas, and they are of satisfactory accuracy on those systems for which the Brownlee phase angle formulas are valid. Using the new formulas, a satisfactory agreement with the actual losses is obtained for the numerical systems studied.

An additional need filled by this work is the collecting in one place of all the important methods for treating losses in economic scheduling of generation problems. 193 pages. $2.41. MicA 55-1046

SERVOMECHANISM SYNTHESIS THROUGH NETWORK PARAMETERS

(Publication No. 11,619)

William John Chalmers, Ph.D.
Purdue University, 1955

Major Professor: J. R. Burnett

The approach to the synthesis of bilateral force-reflecting servomechanisms has been made through the medium of electrical network synthesis theory. The electromechanical system which is the bilateral servomechanism has been represented by an analogous electrical network. Specifications as to the feel, force, and position transfer ability of the bilateral servomechanism have been formulated in terms of the admittance parameters of the analogous network. The bilateral servomechanism can then be realized by two unilateral servomechanisms connected back to back, and the admittance parameters of the unilateral servomechanisms are related to the admittance parameters of the bilateral servomechanisms.

The realization of the unilateral servomechanisms is restricted to the class having a positive real driving point admittance. This means that the unilateral and bilateral servomechanisms will be stable under any passive load condition; in the past servomechanisms in general were stable only for restricted load parameter ranges. This realization allows manipulators to be synthesized without question of their stability under any load conditions. The realization of the unilateral servomechanisms requires the use of network synthesis theory to find the necessary compensation networks for the fixed part of the system.

97 pages. $1.21. MicA 55-1047

THE TIME DISPERSION OF SECONDARY ELECTRON EMISSION

(Publication No. 11,504)

Edward Willis Ernst, Ph.D.
University of Illinois, 1955

During the period beginning about 1920, the phenomenon of secondary electron emission has played an increasingly important role in the operation of electron tubes. As a direct consequence of the increasing utilization of secondary electron emission under operating conditions where a fast response is necessary such as is the case with photomultipliers, multipactors, and other microwave tubes, an increase of the knowledge related to the time factor of secondary electron emission has become highly desirable. Because of the incomplete state of the theoretical knowledge of this phenomenon, the problem of learning more about the time of liberation of secondary electrons is confined today mainly to experimental methods.

Experimental methods of measurement fall into two categories, direct and indirect types of measurement. In this study the direct method, in which the secondary electrons themselves are the subject of the measurement, has been chosen, since indirect methods depend on the observation of a phenomenon which is, in turn, influenced by the action of the secondary electrons.

The particular method employed here is to bombard the secondary emission target with electron bunches of extremely short duration and then focus the resulting secondary electron bunch on a fluorescent screen. In order to make a comparison of the duration of the primary and secondary electron bunches, which yields a measure of the time dispersion of secondary electron emission, the duration of the two individual bunches has to be determined. This has been achieved by deflecting the electrons across the fluorescent screen with a sweep speed sufficiently high that a resolution of approximately one micro-micro-second is obtained. The experiments were carried out by creating with an especially designed bunch forming system a primary electron bunch having a duration corresponding to the resolution time of the system and directing this bunch to the secondary emission target and observing the duration of the resulting secondary electron bunch.

The data obtained in the initial experiments indicate that the total dispersion time involved in secondary electron emission is less than 6×10^{-12} second. This upper limit of the dispersion time is at least an order of magnitude less than any results previously obtained by a direct method of measurement.

Although this study has been directed toward the determination of the time element of a particular phenomenon, it is expected that it will be applicable to other instances where time measurements of high resolution are necessary.

143 pages. $1.79. MicA 55-1048

FOUR-BRUSH METADYNE TRANSIENTS

(Publication No. 11,402)

Kenneth Allen Fegley, Ph.D.
University of Pennsylvania, 1955

Supervisor: Y. H. Ku

A metadyne is a machine provided with an armature, having a commutator upon which bear at least three brushes per cycle of the machine. This paper deals with four-brush metadyne generators and transformers that have a load current which is essentially independent of load impedance.

The following items are considered:

1. Stability of the metadyne generator and the metadyne transformer. The simple metadyne transformer is completely stable. Metadyne generator instability may occur. Stable operation is, however, easily obtained.
2. Methods of damping. The use of a short-circuited stator winding is a new method of damping that is superior to either resistance damping or series winding damping. This new method of damping permits rapid adjustment of damping for each new load condition and has no effect on the steady-state operation of the metadyne.
3. Speed of response. It is shown that the speed of response of the metadyne generator and the metadyne transformer is very rapid when compared to the speed of response of other rotating machines. The effective time constant of a metadyne generator can be much shorter than the time constant of any of the circuits in the generator. This short effective time constant is achieved without the addition of external resistors and hence high efficiency can be maintained.
4. Effect of eddy-currents. The effect of eddy-currents on the transient response of metadynes is small if all of the iron in the magnetic circuit is laminated. Eddy-currents may be quite important and even beneficial when not minimized by laminating the iron.
5. Effect of saturation. The peak transient flux in a stable metadyne generator may be many times as large as the steady-state flux. Transient saturation, therefore, may be an important consideration even though steady-state saturation does not occur. The increased damping that occurs with transient saturation is desirable.

The parameters of a four-brush machine were determined experimentally. The d-c tests used determine not only the parameters of the real windings but also the time constant of the eddy-current transients in the iron of the machine.

The test machine was operated both as a metadyne transformer and as a metadyne generator. The transient response for both transformer and generator operation was determined and is recorded on oscillograms.

Equations for the currents in the several windings of a metadyne are found by application of tensor methods.

A differential analyzer study was made to determine the transient behavior of the metadyne. By using experimentally determined parameters in the differential analyzer study, a check is obtained between the experimental determination of the transient response and differential analyzer solutions.

132 pages. $1.65. MicA 55-1049

THE SUSCEPTANCE OF A CIRCULAR IRIS TO THE DOMINANT TE_{11} MODE IN CIRCULAR WAVEGUIDE

(Publication No. 11,871)

Morris Handelsman, Ph.D.
Syracuse University, 1955

The impedance behavior of a round iris obstacle in a circular waveguide propagating the dominant TE_{11} mode has been solved using a variational method based upon the tangential aperture electric field. The complete range of iris sizes has been investigated, from small to large. In addition the important effects of finite obstacle thickness have been taken into account, using a technique based upon methods developed by Marcuvitz and Oliner.

The trial aperture field for the large aperture case is similar to that of a TE_{11} mode. For the small aperture case, two different trial fields have been chosen. One is a field based upon published work by Bethe on the diffraction of small holes in screens; the other is based upon similar work by Bouwkamp. It is shown that the variational solutions for both fields reduce to the same equation in the limit of vanishingly small aperture size, and that this equation is identical with one previously published, which is derived by a non-variational method.

In order to compare theoretical results, and to obtain numerical values for comparison with published experimental data, it is necessary to accurately, or in some cases, exactly sum infinite series whose terms are Bessel functions. These series are either of the Schlomilch type, or are of the type where each term is the product of two Bessel functions, or the square of a Bessel function, etc. The Bessel functions are of the first kind, of integer or fractional order. These series have been summed by either exact closed-form formulas or have been converted into more rapidly convergent series suitable for numerical computation.

Graphical and tabular comparison is given between theoretical results and published experimental data taken by the Bell Telephone Laboratories and the Massachusetts Institute of Technology Radiation Laboratory, for all iris sizes and various thicknesses. The agreement is considered good.

193 pages. $2.41. MicA 55-1050

THE USE OF TRANSISTORS IN ASYNCHRONOUS DIRECT-COUPLED COMPUTING CIRCUITS

(Publication No. 11,514)

Robert Ayer Kudlich, Ph.D.
University of Illinois, 1955

Reliability is one of the most important requirements for the circuits which are to be used in large-scale automatic digital computers. In many cases, the vacuum tubes themselves are the weakest point with respect to reliability. The problem considered here is the possibility of using transistors rather than vacuum tubes in one particular type of computing circuitry: direct-coupled, asynchronous computing circuits.

In this type of circuitry, the binary signals are dc voltage levels, and the proper operation of the circuits is essentially independent of their transient characteristics. It is therefore possible to design such circuits by considering the dc voltage levels at certain points in the circuit under various operating conditions.

The types of "building block" circuits which are analyzed include the temporary storage device, or TSD, and logic circuits for the functions and, or, and not, and combinations thereof. The analysis of each circuit led to a set of requirements to be satisfied by the values of the circuit components. For each circuit, one sample design which meets these requirements is presented, and experimental results obtained with these sample circuits are described.

The TSD, which holds a single binary digit, and produces the binary signals which drive the logic circuits, includes three sections. The basis of the TSD is the flip-flop, a bistable circuit. The flip-flop is set to the desired state by gating circuits. Read-out circuits act as isolation and impedance matching stages between the flip-flop and the logic circuits being driven. Three flip-flop circuits were studied, two using point contact transistors, the third junction transistors. Each flip-flop uses two transistors, one being cut-off, the other conducting, in each of the two stable states.

The two point contact transistor circuits have the same configuration. In the first version, the conducting unit is not allowed to saturate, and extremely rapid response is obtained. However, severe restrictions must be placed upon the transistor characteristics. In the second version, the conducting unit may operate in either the active or saturation regions. This causes slower operation, but allows much greater variation in the transistor characteristics.

The junction transistor flip-flop is analogous to the familiar Eccles-Jordan tube circuit. The circuit is quite reliable, but considerable delay is involved in changing the state of the flip-flop.

The second of the three flip-flops was considered most desirable for transistors currently available, and the remaining sections of the TSD are designed to operate with this circuit. The gating and read-out circuits use junction transistors. The sample TSD design has a response time of about two microseconds.

Several types of logic circuits are described. The advantages and disadvantages of diode circuits, junction transistor circuits, and circuits using both types of devices for the logic functions and and or are considered. An analysis is presented of the necessary characteristics of these circuits in order to prevent excessive deterioration of the binary signal levels in successive logic stages.

Two types of not circuit, both based upon the grounded-emitter configuration with junction transistors, are analyzed. One uses a conventional resistance voltage divider, the other a "breakdown" silicon junction diode, to obtain the desired dc levels.

The complete set of sample circuits designed with the saturating point contact transistor flip-flop as a nucleus is considered to be sufficiently reliable for computer elements, although more stable point contact units than are presently available would be required. Possible future developments and lines for future investigation are discussed.

247 pages. $3.09. MicA 55-1051

INVESTIGATION OF A CONTACTOR SERVOMECHANISM INVOLVING OUTPUT FRICTION

(Publication No. 11,642)

Jean Pierre Magnin, Ph.D.
Purdue University, 1955

Major Professor: J. R. Burnett

This thesis presents a study of a contactor servomechanism involving output friction.

The most important properties of phase plane portraits are first presented and then applied to non-linear servomechanism theory as it has appeared in the recent literature.

This approach is used to study the phase plane portrait of a contactor servomechanism with output friction. The optimum torque reversals are investigated and an approximated formula is derived for the system switching time. General considerations are given about the design of such servomechanisms.

The contactor servomechanism is compared to a linear system presenting a limitation on the power requirements. Both control systems have the same fixed part and same input. A comparison is made from the standpoint of mean square errors, settling times, peak and average powers and accelerations. The results are thoroughly explained and interpreted.

Conclusions are drawn about the goodness of optimized on-off systems as compared to linear systems, the influence of output friction in their performance and their response to statistical inputs.

110 pages. $1.38. MicA 55-1052

NUMERICAL ANALYSIS FOR NETWORK DESIGN

(Publication No. 11,643)

Hagop Markarian, Ph.D.
Purdue University, 1955

Major Professor: G. R. Cooper

The method of numerical analysis presented in this dissertation is based on a new approach to the formulation of sectional approximation of continuous functions. The approximation is characterized by the fact that when a n-order approximation is differentiated n times, it produces impulses at points t = 0, T, 2T, etc., where the approximation and the continuous curve coincide. It should be noted that, approximations of order two and higher produce in addition an impulse at t = -T. The n-order approximation is, therefore, one that is obtainable by integrating n-times a certain impulse sequence which is related to the sample sequence of the continuous function through a n-order integrating operator. Hence, the Laplace transform of a n-order approximation is equal to the Laplace transform of the pertinent impulse sequence times $\frac{1}{s^n}$. If, for instance, $f_a(t)$ is the n-order approximation of the continuous function f(t), the Laplace transform of $f_a(t)$ is

$$F_a(s) = \left[F(z) \cdot \frac{1}{I_0^n(z)}\right] \frac{1}{s^n}$$

where F(z) is the Z-transform of f(t) — that is, the Laplace transform of the samples of f(t) with ϵ^{sT} replaced by z — and $I_0^n(z)$ is the Z-transform of a n-times integrated unit impulse function. The bracketed quantity is the transform of the sequence of impulses which give $f_a(t)$ when integrated n-times.

The formulation of the Laplace transform of the sectionally approximating curves simplifies the performance of linear operations a great deal. It makes it unnecessary to have a long list of formulas. A list of integrating operators is all that is needed to derive all relations when needed. A table of integrating operators of order up to the tenth is included in the text.

The result obtained after carrying out a specified set of operations on a sectional function is a new sectional function. Its transform contains information about it not only at the sampling instants but at mid-interval points also. This information is readily obtainable by Z-transforming the result with a sampling period which is a submultiple of the sampling period initially used for the solution of the problem.

The facility the new approach brings to numerical analysis is brought out by applying it to the transient analysis of open and closed loop systems, and closed loop systems with transportation lag. It is also applied to the solution of linear differential equations with constant coefficients. Directly related to the method of solving differential equations is a method of approximate inversion of Laplace transforms that is a contribution of the new method of analysis.

Another contribution of the method is a procedure for time-domain synthesis, that is approximating a given function with one that is physically reliable as the impulse response of a network.

123 pages. $1.54. MicA 55-1053

DEBUNCHING IN HIGH DENSITY ELECTRON BEAMS

(Publication No. 11,549)

Myron Weinstein, Ph.D.
University of Illinois, 1955

The role of the space charge forces in the behavior of the electrons in a finite diameter electron beam undergoing velocity modulation has been investigated in this work.

A complete mathematical solution to this problem would require a solution to Newton's laws of motion along with Poisson's equation in a three-dimensional medium and this turns out to be an insurmountable task for the structures which are used. An approach, which considers the space charge force on the axis of a cylinder (and thus has one-dimensional variations) along with treating the problem in a medium where the variations in electron density are periodic in space, has led to a practical quantitative solution up to the point of electron crossover for the behavior of the electrons in a finite diameter beam which has been velocity modulated. The behavior of the electrons is explicitly expressed in terms of arrival time and velocity at a particular point along the beam in terms of the departure time at the modulating source, the sinusoidal modulation imparted to the beam, the DC current density, the DC beam velocity, the beam diameter and the distance the modulated beam is allowed to travel.

An elaborate beam analyzing system is used which deflects the beam at a particular point of interest in the y direction with simple harmonic motion at a 3000 megacycle per second rate — the exact modulating frequency — and linearly in the x direction according to the deviation from the DC beam velocity at the point of observation. Thus the repetitive time variation in velocity at the point of interest is transformed into a repetitive geometrical trace on a fluorescent screen.

Independent control of the DC current density, the velocity modulation and the beam diameter enabled a complete check to be made of the aforementioned theory as well as the inadequacies of previous theories. The striking feature of the theory presented in this thesis is that the resultant space charge force on an electron depends on its original position in the modulation cycle — in other words, electrons in the vicinity of the bunch are more strongly influenced by the space charge forces than electrons that are more distant from the center of the bunch which is in strong contrast to the previous theories. Verification of the theory by the actual behavior of the beam is clearly demonstrated in the experimental spectrograms.

The analyzing system not only enabled a thorough check to be made of the behavior of the electrons as

predicted by the theory obtained in this work but also provided adequate experimental information for a qualitative analysis of the behavior of electrons in a beam that has been sufficiently modulated so that electron crossovers occur.

The effects of the complex and fast changing space charge forces after electron crossover are very markedly portrayed in the experimental spectrograms when electrons possess sufficient energy to overcome the retarding space charge forces and pass the center of the bunch. After crossover the space charge forces have just the opposite effect and this is graphically displayed as an increase in velocity and displacement in the cycle for those electrons which remain ahead of the center of the bunch.

The results of the qualitative analysis after crossover lead to a satisfactory explanation for the marked diminution of higher harmonic current content of klystrons noted in previous studies.

154 pages. $1.93. MicA 55-1054

ENGINEERING, INDUSTRIAL

THE EFFECT OF JOB DIFFICULTY FACTORS ON TIME, ENERGY, AND ACCELERATION OF MOTION PATTERNS

(Publication No. 11,675)

Joseph Wray Wilkes, Sc.D.
Washington University, 1954

Chairman: Gerald Nadler

Motion and time study deals with relationship of operator motion, pace, and job difficulty factors. Since there is need for determination and evaluation of these relationships, four laboratory experiments were performed with subjects who were given intensive training to simulate industrial situation.

Within the experimental conditions and limitations the following conclusions may be drawn.

1. Two hand motion patterns show reductions in performance from one hand patterns.
2. Increasing weight handled reduces performance.
3. Increasing positional eye-hand coordination requirements reduces performance.
4. Increasing directional eye-hand coordination requirements reduces performance.
5. Increasing level of muscular squeeze control reduces performance.
6. Amounts of acceleration and deceleration are not identical in a motion.
7. Deceleration has a closer relationship to job difficulty than acceleration.
8. Motions are not independent in a sequence.

147 pages. $1.84. MicA 55-1055

ENGINEERING, MECHANICAL

SMALL DEFLECTIONS OF ELASTICALLY SUPPORTED RECTANGULAR PLATES

(Publication No. 11,508)

Alfred Hartmann Hausrath, Ph.D.
University of Illinois, 1952

This paper is concerned with the small deflections of thin elastic plates supported on an elastic subgrade. By using the method of Bergman, a relationship is developed involving the deflection of such a plate with clamped edges, referred to as Problem C, the deflection of a similar plate with free edges, denoted as Problem F, and a kernel function. By utilizing this relationship, the solution to Problem F can be found in terms of Problem C, and conversely, once the kernel function is known. The method of Bergman involves the construction of a Green's function for each of these boundary value problems. From these Green's functions, simple quadrature yields the desired solutions.

As an example of this method, the Green's function for a clamped square plate on an elastic subgrade is constructed along with the kernel function, both for a particular parameter. From these functions, the solutions to Problem C and Problem F are found. 34 pages. $1.00. MicA 55-1056

EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER BY FORCED CONVECTION FROM A HEATED RADIAL-FLOW TURBINE ROTOR TO COOLING AIR

(Publication No. 11,652)

Ernest Nicholas Petrick, Ph.D.
Purdue University, 1955

Major Professor: Dr. M. J. Zucrow

An investigation of forced-convection heat transfer in the turbulent regime with air flowing perpendicular to and parallel to the back shroud of a rotating radial turbine rotor was conducted over a range of surface temperatures from 750 R to 870 R, inlet air temperatures from 520 R to 570 R, and heat fluxes from 1000 to 50,000 BTU per hour per square foot. The turbine disk was rotated at speeds from 8800 to 16,300 rpm; the spacing between the disk and the stationary back casing was maintained at a constant value of one-eighth inch. The data discussed herein are for heat addition to the cooling air, and were obtained with the air flowing radially inward and radially outward parallel to the disk, and perpendicular to the disk in the vicinity of the tip and the shaft of the disk.

The local heat transfer coefficients were correlated by defining a modified Reynolds number in which the physical properties of the cooling air are computed at the average bulk temperature, the characteristic velocity is the vector sum of the local air

velocity and the local surface speed of the disk, and the characteristic length for parallel flow is the spacing between the rotating disk and the stationary back casing. In the case of perpendicular flow, the Reynolds number is defined in an analogous manner with the exception that the characteristic length is the diameter of the disk at the point where the cooling air is injected. 95 pages. $1.19. MicA 55-1057

DYNAMIC VISCOSITY OF NITROGEN AND CARBON DIOXIDE AT HIGH PRESSURES

(Publication No. 11,658)

Joseph Michael Savino, Ph.D.
Purdue University, 1955

Major Professor: W. L. Sibbitt

The ultimate purpose of this viscosity project was to design and construct a viscometer which would be used to determine the viscosity of gaseous air, nitrogen, carbon dioxide and water vapor at high temperatures and pressures. A steady flow capillary type viscometer was constructed to operate at pressures up to 7500 psi and temperatures to 1500°F. The capillary O. D. was 0.25 inch, and the I. D. varied from 0.0820 to 0.0850 inch. The length was 498'-10 3/4 inches. The capillary was wound into a coil having a 10 foot diameter and was housed in a specially designed furnace. The pressure drop between the capillary ends was measured with a "U" type manometer, and the volume rate of flow was measured with a meter. Steady flow was maintained with a pressure regulator.

The capillary was calibrated with nitrogen gas. Poiseuille's Equation for steady laminar flow with the appropriate corrections for the curvature was applied. Corrections for end effects and slippage were negligible.

For this thesis viscosity data are given for nitrogen and carbon dioxide at 21°C and in the pressure range 1000 to 4000 psia and 14 to 700 psia, respectively. From the calibration tests an average capillary I. D. of 0.08313 inch was determined.

77 pages. $1.00. MicA 55-1058

INVESTIGATION OF NOISE SILENCERS FOR FLUID-FLOW MACHINES

(Publication No. 11,669)

Harold Leroy Taylor, Ph.D.
Purdue University, 1955

Major Professor: R. C. Binder

An investigation was made of silencers for reducing the noise of fluid-flow machines. This investigation was divided into two sections. In the first section a study was made of the fundamental principles of noise reduction and the fundamental principles of silencers. In the second section these fundamental principles were applied to reduce the sound output of a small, pneumatic drill. In carrying out this application an engineering approach was established for the systematic application of the basic principles.

Considering the fundamentals of noise control and noise silencers, a general study was made of absorption and wave-cancellation silencers. The absorption silencers were eliminated from further study because such silencers would greatly increase the bulk and back pressure of fluid-flow machines.

A literature survey was made for basic principles that apply to wave-cancellation silencers and for information concerning actual applications to noise reduction. The material reported in the literature indicated that the Helmholtz resonator and finite-acoustic filters could be applied as silencers. Basic relationships and verifying experimental data which were presented in the literature for the Helmholtz resonator only applied to the low frequency ranges, below 600 cycles per second. Basic relationships and verifying experimental data were also lacking that completely explained the action of finite-acoustic filters throughout the audible-frequency range.

Applying the mobility method, frictionless analyses were made of three acoustic systems:

1. A Helmholtz resonator,
2. A combination of one volume and two necks, and
3. A combination of two volumes and three necks.

A method for obtaining transmission data was devised and experimental data were presented for these three systems.

The silencer studies showed that each of the three acoustic systems would reduce noise components with frequencies above 600 cycles per second at least 25 decibels. Reductions of this magnitude constitute complete removal of the noise component. For the Helmholtz resonator the attenuation band was seen to be narrow. For the other two acoustic systems wide attenuation bands were obtained. Except for the upper-pass band limit expressions for the volume and neck combinations, the analytical expressions presented for the three acoustic systems closely agreed with the experimental results.

Noise reduction work was performed on a small, vane-type, pneumatic drill. The combination of two volumes and three necks was applied to this drill. This application reduced the total sound-pressure level from 98.5 decibels to 80 decibels, a reduction of 18.5 decibels. Moreover, the loudness in sones was reduced from 284 to 51 sones, a reduction in total loudness of 82 per cent. This impressive reduction of the drill noise was accomplished with only a 10.5 per cent reduction of the no-load output speed.

Applying the combination of one volume and two necks to the drill, reductions of 76.5 per cent in the total loudness and 16.5 decibels in the total sound-pressure level were obtained with a reduction of only 6.6 per cent in the no-load output speed.

Noise silencers were established which could effectively reduce the noise of fluid-flow machines,

and basic principles were presented in this study which were valid for silencer design.

151 pages. $1.89. MicA 55-1059

ENGINEERING MECHANICS

CREEP DEFORMATION OF COLUMNS

(Publication No. 11,487)

Roland John Benjamin, Ph.D.
University of Illinois, 1955

If a constant load is applied to a slightly deformed column which is constructed of a material subject to creep deformation, the column may collapse after some finite time interval even though the applied load is less than the conventional short-time buckling load.

In this dissertation there is established a general analytical basis for determining the period of time for which a column of arbitrary cross section, constant along the column length, can sustain a given constant load before collapse.

Based upon certain engineering hypotheses as to the creep behavior of a material subjected to a time-varying stress and postulating that the deflected shape of the column is at all times sinusoidal, the mathematical analysis is shown to lead to an integro-partial differential equation relating an inelastic strain parameter to a time parameter. The collapse time for the column is then defined as that time at which the inelastic strain parameter tends to increase without bound at any point of the column cross section.

Because of the complexity of the differential equation, it was not possible to obtain an analytical solution. Numerical integration methods could be conveniently employed, however, and numerous solutions were obtained in this manner using an electronic digital computer (the IBM Type 701 machine). Material constants used were typical of those for 24S-T3 aluminum alloy in compression at 500°F.

The results of these computations are presented in such a fashion as to illustrate the effect upon the column collapse time of varying the column slenderness ratio, applied load, initial deflection, cross sectional shape, and form of creep law assumed to be valid for the material. It is shown that convenient design curves may be prepared from which allowable stresses to obtain specified column lifetimes may be determined directly. 63 pages. $1.00. MicA 55-1060

ENGINEERING, METALLURGY

THE EFFECT OF ALUMINUM ON THE HIGH TEMPERATURE OXIDATION RESISTANCE OF TITANIUM AND ZIRCONIUM

(Publication No. 11,294)

Wilbur Garner Holmes, Ph.D.
University of Michigan, 1955

The oxidation characteristics of 3% aluminum alloys of commercial titanium and zirconium were compared with the behavior of their respective base metals when oxidized under the same conditions in order to ascertain why aluminum additions increase the oxidation resistance of titanium and decrease the oxidation resistance of zirconium.

Kinetic behavior of the metals was studied with the aid of a thermobalance and correlated with the results of metallographic and X-ray diffraction studies. The oxidation behavior of titanium and zirconium was similar in that the zone of oxide formation for both metals was at the metal-oxide interface and porous scales formed on both metals when severely oxidized.

Titanium and its aluminum alloy were oxidized in air and oxygen in the temperature range 1200°-1600°F. Above 1400°F. the oxidation product on both metals was porous, and the oxidation rate obeyed the linear law. Below 1400°F. the scale formed on the two metals was protective in nature and oxidation proceeded parabolically. At all temperatures, the aluminum alloy oxidized more slowly than the base metal.

X-ray and electron diffraction investigations of the scales formed on titanium indicated the presence of TiO_2 as rutile only. On the aluminum alloy, alpha alumina co-existed with rutile in roughly the same ratio of metals as in the alloy.

The activation energy for the oxidation reaction of titanium was 49,300 cal/gram mole as compared to 50,400 cal/gram mole for the aluminum alloy. This indicates little influence of aluminum on the energetics of the diffusion process which appears to consist predominantly of oxygen ion movement.

The influence of aluminum in retarding the oxidation of titanium appears to be (1) a barrier effect on the diffusion of oxygen exerted by the alumina in the scale, and (2) a reduction in the porosity of the growing scale due to decreased expansion of oxide forming near the metal interface.

Zirconium and its 3% aluminum alloy were oxidized in air and oxygen in the temperature range 1100°-1400°F. In general the oxidation characteristics of these two metals were similar.

The oxidation kinetics of zirconium exhibited an initial stage of decreasing oxidation rate which was followed by a final stage of destructive oxidation.

The initial scale formed on the zirconium was hard, black, adherent and protective. This scale was composed of monoclinic and tetragonal ZrO_2. On continued oxidation this black oxide transformed to a pink scale which exhibited cracks; this transformation signified the advent of destructive oxidation.

The scale formed after the breakdown of the protective oxide was white in appearance and porous in

nature; beneath this scale and adjacent to the metal was always found a thin layer of black oxide. The white scale consisted entirely of monoclinic ZrO_2.

On the aluminum alloy the initial black scale consisted of monoclinic and tetragonal ZrO_2 but contained more of the tetragonal modification than found in the black scale on zirconium. The white oxidation product formed on the alloy under conditions of destructive oxidation consisted of tetragonal ZrO_2 mixed with a smaller amount of monoclinic modification. Since tetragonal ZrO_2 is 8.5% more dense than the monoclinic form, the porous scales on the alloy in forming from the thin black monoclinic oxide undergo considerable contraction not experienced by the porous scales formed on zirconium. This contraction results in oxidation of a more destructive nature for the alloy than for the base metal.

The initial protective scale underwent immediate breakdown on as-rolled alloy specimen oxidized at 1100°F. and on annealed alloy specimen oxidized at 1200°F. This resulted in a much higher rate of oxidation for alloy specimen than for zirconium samples oxidized under similar conditions.

The activation energy for the oxidation reaction was 34,900 cal/gram mole for zirconium as compared to 26,700 cal/gram mole for the alloy. This difference supports the X-ray diffraction evidence that aluminum enters the zirconium oxide lattice rather than forming a discrete oxide phase as in the case of the titanium-3% aluminum alloy.

229 pages. $2.86. MicA 55-1061

GRAIN BOUNDARY DIFFUSION IN THE COPPER-BISMUTH AND COPPER-NICKEL SYSTEMS

(Publication No. 11,378)

Sumio Yukawa, Ph.D.
University of Michigan, 1955

Diffusion in the grain boundary regions of metals was studied in this investigation. Primary consideration was given to the influence of crystallographic misfit between the grains on the nature and rate of diffusion as a function of time and temperature for several metallic systems. The systems were the bismuth-copper, nickel-copper and to a limited extent, nickel-iron. In conjunction with these studies, some of the capabilities and limitations of high resolution autoradiography as a tool for metallurgical research were evaluated.

The influence of crystallographic misfit was studied by using bicrystals of copper of predetermined orientations grown by means of controlled solidification from single crystal seeds. The bicrystals had a common cube axis and the degree of crystallographic misfit was taken as being the angle formed by the other cube axis of each grain of the bicrystal. Crystallographic orientations were measured by x-ray and etch-pit techniques. In addition to diffusion into bicrystal boundaries, studies were also made of diffusion into polycrystalline copper boundaries and in the case of nickel-iron system, the study was confined to polycrystalline iron only.

The diffusion of bismuth into copper was studied by exposing samples of copper to stable and radioactive bismuth liquid and/or vapor at a given diffusion temperature under a hydrogen atmosphere. The diffusion of nickel into copper and into iron was investigated by electroplating radioactive nickel on the samples and giving them a vacuum diffusion anneal. The diffusion specimens were sectioned and examined for the extent of grain boundary diffusion by conventional metallographic techniques and by the stripping film method of high resolution autoradiography.

The results for the bismuth-copper system indicate that metallographic methods of detecting bismuth in copper grain boundaries are inadequate and inconclusive. The autoradiographic technique gives only an indirect evidence for the presence of bismuth. The most conclusive evidence for the diffusion and presence of bismuth in copper grain boundaries was found to be a test of the fracture strength of the boundary. When the angle of misfit was between approximately 25° and 63°, the bicrystal boundaries became extremely brittle after exposure to either bismuth liquid or vapor for 12 hours at 650°C (1200°F). Bicrystal boundaries with misfit angles outside of this range were not embrittled under the same conditions.

The extent of diffusion of nickel in grain boundaries of copper, in excess of normal lattice diffusion, was determined autoradiographically and found to be dependent on the crystallographic misfit angle. The maximum penetration for a given temperature and time occurred at the maximum misfit angle of 45°. The coefficients for the grain boundary diffusion of nickel in copper were calculated using available mathematical analyses of grain boundary diffusion in metals. These mathematical treatments were found to be satisfactory for boundaries having high degrees of misfit but only approximate for small misfit boundaries. The ratio of grain boundary diffusion to lattice diffusion coefficients was found to be a function of the misfit angle and of the diffusion temperature in the range from 650°C (1200°F) to 825°C (1517°F). The grain boundary diffusion coefficients of nickel into copper are 10^4 to 10^5 times larger than lattice diffusion coefficients in this temperature range. The diffusion coefficients were correlated with diffusion temperature by an Arrhenius-type equation and the activation energy calculated from this correlation ranges from 64.8 kcal./g. mol for lattice diffusion to 38.5 kcal./g. mol for diffusion in a boundary of maximum misfit. The largest decrease in the activation energy for grain boundary diffusion occurs in the range of small misfit boundaries.

The results of the study of diffusion in the nickel-iron system were limited to showing qualitatively the occurrence of grain boundary diffusion of nickel in both alpha and gamma iron.

The overall conclusion that can be drawn from the results of this investigation is that diffusion along grain boundaries of metals occurs at a much more rapid rate than in the normal lattice structure and that this rate is intimately related to the relative crystallographic orientations of the grains forming the boundary.

152 pages. $1.90. MicA 55-1062

FINE ARTS

CUBISM: 1907-1914

(Publication No. 11,449)

Herschel Browning Chipp, Ph.D.
Columbia University, 1955

During the years 1907-1914, most of the major characteristics of Cubist art were established, and the basis for much of later abstract painting was laid, as is attested by the different directions pursued by the various movements arising from Cubist innovations. This stage was concluded in 1914, when the French artists left their studios for the war, and the Spanish element, more austere and anti-realistic, prevailed.

There were two groupings in the early development of the movement. First, there were the artists who gathered at the Bateau Lavoir with Picasso and Braque. They found stimulus for their painting innovations in Cézanne, in the presence among them of Henri Rousseau, and in African sculpture. The second group was made up of the painters and poets who began to meet together in 1911 at Puteaux, and there engaged in discussions on theories of color and of visual perception. The violent criticism aroused by their several group exhibitions caused them to develop and defend their own explanations of Cubism.

The second half of this paper consists of a discussion of the Cubist ideology based on writings and recorded statements of the painters and poets, and on personal interviews with many of them. An attempt is made to describe the movement under the headings of primitivism, conceptual realism, subject matter, and space.

The Cubists had inherited an interest in African sculpture from the Fauves, but, in contrast to their predecessors, saw in it a justification for some of their own plastic innovations, and, during one phase, found in it models for their own forms. The Cubists were convinced that their painting differed from that of preceding schools, since they relied upon the mind as a logical faculty that controlled and ordered the sensations, and thus they avoided the impressionistic and symbolic nature of much previous painting. These artists maintained a reference to tangible, physical things, but valued them only as the source of lines and forms that could be transformed and reconstructed into the realm of their painting. They felt that they had produced a kind of painting that was rich with plastic values, without the presence of recognizable subject matter, even though their forms may have been originally derived from real objects. Cubist space was of a different sort from that of the real world, because it took into account the properties of the canvas and the painted elements of the picture. In it could be simultaneously seen several views of an object suggesting that the Cubists created a composite view of things that was part visual and part conceptual. Since their pictures seemed to lack reference to specific moments in time or to particular, measurable positions in space, the poets and painters began to use the term "fourth dimension" in connection with their painting. Their interest in explaining Cubist space led some of them to a study of geometry which seemed to represent for them not a belief in geometric essences, nor a method of constructing harmonious proportions, but a model of order and a logical working procedure. 186 pages. $2.33. MicA 55-1063

FOOD TECHNOLOGY

STUDIES ON MEDIA COMPOSITION AND HEAT ACTIVATION FOR THE DEMONSTRATION OF VIABILITY OF SPORES OF BACILLUS STEAROTHERMOPHILUS

(Publication No. 11,491)

Bernard Aaron Brachfeld, Ph.D.
University of Illinois, 1955

The study of spore germination of the aerobic thermophiles is important to the food microbiologist for two reasons. First, they are responsible for a large economic loss each year to the canning industry. Secondly, the spores of these organisms are very heat resistant. Therefore, they are frequently used as reference organisms in thermal process calculations, i.e., the thermal processing conditions to which a product must be subjected in order to render it commercially sterile.

Many difficulties have been encountered in evaluating the survivors of a processed pack. These were attributed to the inadequacy of the plating medium, and, possible, to inadequate procedures. Therefore, it was decided to study the processes and techniques for the demonstrations of viable spores of Bacillus stearothermophilus NCA 1518. This study included the effects of media composition, heat activation and possible germination stimulants.

Conditions of time and temperature for heat

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

activation were found to be important. The usual conditions of 95° to 100° for ten to fifteen minutes were found to be inadequate. Heat activiation at 105° C for five minutes gave maximum plate counts. Heat activation at temperatures of 55°, 65°, 75° and 85°C were found to induce dormancy. This phenomenon of heat-induced dormancy could be partially reversed if the spores were subsequently reactivated at 105 °C for five minutes.

Following heat activation at 105 °C for five minutes, counts of the spores were found to decrease within a short time indicating deactivation or possibly death.

Heat activation in skim milk was found to result in higher plate counts than activation in water or other nutrients.

Inclusion of 0.005-0.01 molar phosphate buffer in media containing one tenth of one per cent carbohydrate was found to permit development of larger colonies. However, the plate counts were not significantly increased. Substitution of calcium gluconate, potassium gluconate or sorbitol for the glucose in the plating medium limited acid production thereby allowing larger colonies to develop. Use of these alternate carbohydrate sources also appeared to permit a greater total number of spores to germinate and produce colonies.

Investigation of many complex organic substances and defined chemical compounds failed to reveal any stimulation of germination, with the possible exception of monosodium glutamate.

84 pages. $1.05. MicA 55-1064

THE EFFECT OF CERTAIN SPORULATION CONDITIONS ON THE THERMAL DEATH RATE OF BACILLUS COAGULANS VAR. THERMOACIDURANS

(Publication No. 11,502)

Hamed Mohamed El-Bisi, Ph.D.
University of Illinois, 1955

The purpose of this study was to evaluate the effect of several environmental factors, existing during growth and sporulation, on the thermal death rate of spores of B. coagulans var. thermoacidurans (ATCC No. 8038). The factors studied were: (a) the nutrient growth medium, (b) the growth temperature, (c) the hydrogen-ion concentration in the growth medium, and (d) the phosphate level in the growth medium.

Duplicate spore crops were produced on three different media: tomato juice agar, corn concoction agar, and thermoacidurans agar. Other duplicate spore crops were grown on tomato juice agar at three different temperatures: 45 C (113 F), 37 C (98.6 F), and 30 C (86 F). Additional duplicate spore crops were grown on highly buffered tomato juice agar adjusted to different initial hydrogen-ion concentrations: pH 5, pH 6, and pH 7. The tomato juice agar in this latter case contained an initial concentration of 1-percent KH_2PO_4 instead of the normal 0.5-percent added to it in the former two investigations. This difference in the phosphate content of the same growth medium constituted the basis for the fourth investigation, that is, the effect of the phosphate level upon the thermal death rate of the spores produced.

Spore suspensions were prepared and their thermal death rates were determined in duplicate according to a standard procedure. A previously described and specially modified tank-type thermal-death-rate apparatus was built and used throughout these thermal death rate determinations.

The data obtained were subjected to statistical analysis in order to: (a) establish the linearity of the survivor curves, (b) compute the alternative thermal death rate constants "K" and "D" from fitted linear regressions, (c) test for the reproducibility of regression coefficients from duplicate runs as well as duplicate harvests, and (d) test for significant differences among these coefficients obtained under the various environmental conditions investigated.

Several types of abnormalities were encountered in the shape of the survivor curves. Certain reasons and speculations (see Thesis) led us to believe that these abnormalities are, in fact, false indications due to several extrinsic factors and do not disprove the inherent linearity of the survivor curve. The linear parts were, therefore, established and their regression coefficients effectively used in the various comparisons.

Table 1 summarizes the final tests of significance of the differences among thermal death rates due to the various sources of variation.

TABLE 1

SUMMARY OF STATISTICAL TESTS OF SIGNIFICANCE AS APPLIED TO DIFFERENCES IN THERMAL DEATH RATE CONSTANTS OF SPORES OF B. COAGULANS VAR THERMOACIDURANS (ATCC No. 8038), PRODUCED UNDER DIFFERENT ENVIRONMENTAL CONDITIONS

Source	Degrees of freedom	Sum of squares	Mean square	F	P
Nutrient Growth Media	2	0.8502	0.4251	1.51	0.20+
Growth Temperatures	2	28.7610	14.3805	51.20	0.001-
Hydrogen-ion Conc.	2	0.1729	0.0864	3.25	0.20+
Phosphate Conc.	1	11.2640	11.2640	40.10	0.001-
Duplicate Harvests	9	2.5282	0.2809	15.87	0.001-
Duplicate Runs	23	0.4079	0.0177	1.58	0.05+
Unexplained	117	1.3067	0.0112		

The evidence is clear that, while duplicate thermal death runs agreed very well, duplicate harvests showed significant differences in the value of their regression coefficients. However, this significant difference between duplicate harvests was considered when variations due to the main effects were tested.

The nutrient growth medium as well as its hydrogen-ion concentration did not significantly affect the thermal death rate constants, whereas the growth temperature and the phosphate level in the growth medium exhibited a highly significant effect. Higher growth temperatures enhanced the thermal resistance,

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whereas higher phosphate levels depressed it considerably.

The assumption that the temperature coefficient of the death reaction is the same for spore suspensions of the same strain regardless of the difference in their comparative death rates was also investigated. The two spore suspensions showing the highest and the lowest death rates in the growth temperature experiments (the 45 C and the 30 C spore crops, respectively) were employed for this purpose. Phantom thermal death time curves were established for each of the spore suspensions. Fitted least-squares-deviation lines were again used in: first, establishing the thermal death rate constants for each suspension at the various heating temperatures, and second, in computing the "z" value for the two groups of death rates. The two "z" values were then compared, and were found to agree reasonably well.

A theoretical basis for the thermal death time curve was derived. A dual-rate hypothesis was proposed to differentiate between the ultimate (inherent) and the temporary (induced) thermal death rates of spores. The hypothesis also accounts for the difference between thermal death and thermal injury of heated spores. 337 pages. $4.21. MicA 55-1065

STUDIES ON THE SULFITING OF SWEET CORN

(Publication No. 11,509)

Robert Earl Hayes, Ph.D.
University of Illinois, 1955

A study was made of certain chemical, biological and processing factors upon uptake and particle distribution of sulfite by sweet corn from an aqueous salt solution; the mode of entry of the sulfite into the corn kernel; the change in magnitude and distribution of sulfite in the sample particles during drying and storage; the comparison of sulfite level in dried corn with the color of a water soluble extract; and the comparison of sulfiting from a solution to sulfuring with SO_2 gas with respect to evenness of sulfur dioxide application and to the color of the dried products.

The effects of certain factors on the uptake and particle distribution of sulfite from solution by blanched corn are presented. With solutions of from 1/2% SO to 5% SO_2, the uptake is largely confined to an interval of a few seconds after immersion. Temperature has little or no effect between 67° F. and 120° F. Uptake generally increases with decreasing pH of the dipping solution. Deep cut corn contains a high proportion of whole kernels which absorb sulfite poorly; shallow cut corn is high in fragments and the smaller particles which adsorb or absorb sulfite to a high degree. Young corn takes up sulfite better than more mature corn. Sulfite pick-up increases with increasing concentration of dipping solution; the margin between the SO_2 levels of the fragments and whole kernels of a sample also increases with concentration. Freezing and thawing prior to sulfiting enhance uptake. Puncturing the tops of kernel endosperms favors greater absorption, especially by the larger particles. Rinsing with fresh water subsequent to sulfiting reduces the sulfite content of the smaller particles proportionally greater than that of the larger ones. The combination of puncturing prior to sulfiting and rinsing subsequent to sulfiting narrows the sulfite range, to a certain extent, between the largest particles and the free fragments of a sample.

Experiments were carried out to determine the pathway of sulfite entry into kernels. There is strong evidence that the bulk of the sulfite enters the whole kernel through the tip cap and then progresses from the lower to the upper part of the endosperm; the membranes surrounding the whole kernel endosperm are apparently limiting resistances to absorption of sulfite by the kernel. Sulfite absorption increases with decreasing kernel wholeness.

Loss of sulfite during dehydration is proportionally greatest from those kernel parts closest to the drying atmosphere. The loss of sulfite in storage is proportionally about the same for all sample particles, those particles having the highest initial content showing the greatest absolute loss in magnitude.

The intensity of water extracted brown color decreases in dehydrated corn with decreasing kernel wholeness. This color gradation is magnified during storage, illustrating, it is believed, the effect of latent heat damage. The particles and particle sections subject to the highest temperatures during dehydration show the greatest darkening. Free fragments of dried samples show the most intense development of browning during storage even though they have the highest sulfite content. The same color gradation among particles of sulfited corn is found among particles of unsulfited corn, suggesting further that drying temperature may be more important than sulfite supplied by salts as a factor in prolonging storage life.

A preliminary investigation indicates that SO_2 gas may be a better sulfuring agent than an aqueous solution of sulfite, both from the standpoint of dried product color and of evenness of sulfur dioxide application. 90 pages. $1.13. MicA 55-1066

STUDIES OF THE GROWTH AND TOXIN PRODUCTION OF CLOSTRIDIUM BOTULINUM IN A PRECOOKED FROZEN FOOD - INHIBITION BY LACTIC ACID BACTERIA

(Publication No. 11,533)

Mahmoud Ali Saleh, Ph.D.
University of Illinois, 1955

The following factors were studied for their effect on the growth and toxin production of Cl. botulinum (strain 62 type A) in precooked frozen chicken a la king after the food was defrosted: botulinum spore level, type of container, incubation temperature, and incubation period. Botulinum toxin was formed only

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at 86° F (30° C) and not at 50° F (10° C) or during freezing. The botulinum level proved significant at the 0.001 level. There was no significant difference between the carton containers and the metal (plain tin or C-enamel), nor between the 2- and 5-day incubation periods. Three of the twelve samples that received no botulinum spores contained botulinum toxin after incubation at 86° F (30° C). This emphasized the possibility of a botulism hazard when precooked frozen foods are mishandled. The F. value obtained from the analysis of variance of the pH of the samples indicated that the level of botulinum inoculum and the type of container affect the pH.

Three types of lactic acid bacteria were examined for their antagonistic action against Cl. botulinum in "sterile" chicken a la king on incubation at 86° F for 2 and 5 days. Strep. lactis X_{13}, a nisin-producing strain, checked completely the toxin formation in all the 16 samples that were inoculated with botulinum spores. The normal cheese starter failed only in one out of the 16 samples, while Lact. bulgaricus failed in 3 out of the 16 samples. The four toxic samples were from the heavily inoculated group (2×10^3 spores per gram of food) and had been incubated for 5 days. Statistical analysis, however, showed no difference between the effects of the three starters. The average effect of lactic acid bacteria against Cl. botulinum was significant at the 0.001 level. When the experiment was repeated in a food of high initial flora using Strep. lactis X_{13} and "nisoplin" (a dried preparation of the antibiotic nisin) as additives, protection by Strep. lactis X_{13} against botulism was achieved for 2 days only at 86° F. The 5-day samples were generally toxic due to botulism and/or other pathogenic organisms. The "nisoplin" failed to check botulism as well as the gas formers and pathogenic organisms. Salmonella and Shigella organisms were isolated from commercial products. The beneficial effect of lactic acid bacteria against botulism is mostly sporostatic; other modes of action are also discussed.

The above results indicated that there is a good possibility of using lactic acid bacteria as a safeguard against the botulism hazard when precooked frozen foods are mishandled. To achieve the best results, the lactic acid starters should be thoroughly mixed in the food, which should be prepared under the best sanitary conditions, and the samples should be then quickly frozen to minimize contamination and to keep the lactic acid bacteria predominant. Then, if the frozen food is mishandled, the acidity produced in the food will warn the consumer that the food has been mishandled. However, if such a product were consumed, it would be, most likely, nontoxic. Additional work is needed to answer the question of whether Strep. lactis X_{13} or other lactic acid bacteria could completely protect against the botulism hazard in precooked frozen foods.

177 pages. $2.21. MicA 55-1067

A STUDY OF CERTAIN ENVIRONMENTAL FACTORS AFFECTING GROWTH CHARACTERISTICS OF RHODOTORULA GRACILIS

(Publication No. 11,545)

Clifford Henry Spotholz, Ph.D.
University of Illinois, 1955

In this investigation a study was made of the effect of automatically controlled pH and temperature on the rate and total amount of growth of Rhodotorula gracilis. In addition, the efficiency of sugar utilization was investigated, and to a limited extent the effect of oxygen absorption rate on the growth rate.

Most experiments were performed with a fermentor assembly, which consisted of a fermentation vessel, a controlled temperature water bath, pH control equipment, and a system for aeration and agitation. The inocula were grown in erlenmeyer flasks on a shaking machine. The fermentor medium contained Cerelose, yeast extract, ammonium sulfate, and the usual salts. In most experiments the Cerelose concentration was equivalent to 1.33 per cent glucose, and the C/N ratio was 6/1. The rate of growth was calculated by plotting periodic dry weight determinations and measuring the slope of the logarithmic growth curve.

The pH values studied ranged from pH 2.5 to pH 7.5. The temperature was maintained at 32° C. The most rapid growth rate was found to take place at approximately pH 4.5. However, from pH 3.5 to pH 6.5 the rate of growth was very much the same. At pH 2.5 and pH 7.5 the rate of growth was greatly reduced. Within the pH range of 3.5 to 6.5 there was no significant difference in the maximum amount of dry weight of yeast cells produced.

The temperature range studied was from 26° C. to 38° C. The pH was maintained at 4.5. The most rapid growth rate took place at approximately 32° C., which is 3 to 5° C. higher than literature reports indicate is optimum. There was a linear increase in the growth rate from 26° C. to 32° C., followed by a very rapid falling off to no apparent growth at 38° C. There was no significant difference in the maximum amount of dry weight of yeast cells produced between 26° C. and 35° C.

Growth curves were determined for oxygen absorption rates of 1.1 and 3.0 grams of oxygen per liter per hour. At the lower rate, logarithmic growth continued for only a short period of time, followed by a progressively decreasing slope. This data gave a straight line curve on coordinate graph paper, demonstrating an equivalent increase in weight of cell material in each unit of time. This resulted from the presence of oxygen in a limiting but constant amount, since increasing the oxygen absorption rate to 3.0 grams extended the logarithmic growth phase until a much greater cell concentration was reached.

Expressing aeration conditions on the basis of air flow rate was demonstrated to be of little or no value. Thus, by using different spargers, a decrease in the air flow rate of 10 fold actually resulted in a 3 fold increase in the rate of oxygen absorption.

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With the modified aeration system and with optimum growth rate conditions for pH and temperature (pH 4.5 and 32° C.), the generation time was 2.0 hours. This is almost 30 per cent less than the most rapid generation time previously reported for Rh. gracilis.

An efficiency of sugar utilization of 66 per cent, on the basis of sugar supplied, was realized on a defined medium in shake flasks. This efficiency is higher than any known for yeast growing on a defined medium. The residual sugar in the fermentor medium was reduced to practically zero.

A high temperature strain of Rh. gracilis was developed which grew at 41-42° C. The parent strain did not grow above 38° C. However, the most rapid growth rate of the former was not as great as that of the latter.

Placing Rh. gracilis cells in a dry air oven at 100° C. for 2 hours resulted in a produce with a cheesy flavor which was very acceptable to the taste.

95 pages. $1.19. MicA 55-1068

GEOGRAPHY

A GEOGRAPHIC STUDY OF POWER DEVELOPMENT IN THE NIOBRARA BASIN, WITH EMPHASIS ON HYDROELECTRIC POWER

(Publication No. 11,223)

Harold Arthur Classen, Ph.D.
The University of Nebraska, 1955

Adviser: Nels A. Bengtson

Five hydroelectric installations generate power in the Niobrara Basin. Two of them represent improvements upon direct water power plants. The others were built solely for the generation of hydroelectricity.

The hydroelectric plants are incapable of generating sufficient power to meet the needs of the basin. Originally built to supply power for nearby towns, they now operate as parts of an interconnected power system which brings energy into the area. The hydro plants represent 50.8 per cent of the installed generating capacity of the basin, but they constitute 92.2 per cent of the installed capacity which is used for firm power production.

The hydro installations function largely as run of the river plants because the deposition of coarse sediments has virtually destroyed the original water storage capacity of the plants. Run of the river operation is facilitated by the relatively even flow of the Niobrara River and some of its major tributaries. The evenness of flow is due largely to the release of ground water from most of the Pleistocene and Tertiary deposits of the basin, which readily absorb precipitation. The canyon character of the Niobrara and its major tributaries has facilitated the construction of dams.

Power demand in the basin has increased during the last decade despite a decrease in population. Residential and commercial demand has increased in the incorporated areas of the basin. There is virtually no industrial demand for power. Since 1947 farm and ranch consumption has been added to the power market of the basin. The widely-dispersed farmsteads are served by rural public power districts and by cooperatives. An analysis of 182 farms and ranches reveals that electric power use has been largely domestic; it has scarcely entered the agricultural operations of the basin. The prevailing types of farming are ones in which the individual farm or ranch does not have much opportunity to use large amounts of electricity in the farming operation. The largest use of power per farm is on the irrigated farms of the Mirage Flats Project, where agriculture is more intensive and where dairying is an important part of the farm enterprise.

Recent retirement of some generating facilities in the basin has further accentuated the power deficiency. Most of the communities which have retired their facilities are now obtaining energy from rural electrification districts. This arrangement has benefited the towns, the farmers and ranchers, the rural electrification districts, and the power agencies which wholesale energy to the rural districts.

The Bureau of Reclamation has proposed a comprehensive plan of development for the basin which emphasizes irrigation and power development. The potential hydroelectric plants are considered uneconomical at present. The streams of the Niobrara Basin are not capable of generating sufficient power to repay the cost of development over a fifty-year amortization period, based upon the prevailing and potential Missouri Basin rates for federal power. No other power agencies are interested in developing the hydroelectric potential of Niobrara Basin streams because Nebraska law gives preference to irrigation over power in the use of water.

Further hydroelectric developments in the basin appear unlikely, at least for several years. The basin will continue to be a power-deficient area. Power demand will continue to increase, and federal power from Missouri Basin projects will flow into the area in increasing amounts.

287 pages. $3.59. MicA 55-1069

CHANGES IN DISTRIBUTION AND FUNCTIONS OF NUCLEATED SETTLEMENTS OF LEWIS COUNTY, N. Y. BETWEEN ABOUT 1900 AND 1950

(Publication No. 11,873)

Tin Htoo, Ph.D.
Syracuse University, 1955

In this project, we seek to classify nucleated settlements, examine their operative areas for different services,[1] note the intensities of their operation in different sections of their operative areas, and assess the relative importance of different groups of services associated with nucleated settlements. The period 1900-1950 has been covered in our research, because it serves to illustrate striking differences in the distributions and functions of nucleated settlements as between the pre-automobile era and the automobile era.

Chapter I: Lewis County is drained by the south-north flowing Black River, whose valley is fertile, but the adjacent highlands on both sides of it are infertile. In winter, snowfall is heavy, especially on the higher levels. The county population and rural population have declined, but urban population has increased. The settled zone of the county, centered on the Black River Valley, has contracted. While people engaged in agriculture and business and miscellaneous enterprises have declined, those engaged in manufacturing have increased.

Chapter II: On the basis of weighted functional units, a classification of nucleated settlements has been made. The nucleared settlements break themselves down into urban centers, semi-urban centers, and hamlets. While larger nucleated settlements have tended to gain or maintain themselves in population, function, and number, smaller ones have tended to decline in the same. Functional magnitudes of nucleated settlements tend to correspond to their sizes of population. While urban center populations have been increasing steadily, semi-urban populations have been experiencing erratic trends, and hamlet populations have been generally declining.

Chapter III: Because of the expansion in the volume of through traffic, the through service as a factor in the distribution of nucleated settlements has become more important. As the demand for regional service depends to some extent upon the economic condition of farmers, there tend to be more service centers or nucleated settlements on more productive farmlands than on less productive farmlands. Saw-milling and cheese-making have been important in the distribution of nucleated settlements, because they sometimes create nucleated settlements near them.

Chapter IV: While local and through services of nucleated settlements have generally increased, their regional services have generally declined. Local service has generally outweighed regional service, which in its turn has outweighed through service by an appreciable margin. Local service enterprises are confined chiefly to urban and semi-urban centers and they are almost totally absent among hamlets. Tributary areas of urban centers have come to over-lap; those of semi-urban centers have come close to over-lapping; and some of those of hamlets have come to unite and form larger "rural community areas."

Chapter V: Through service, regional service, and industries, coupled with the general distribution of population, determine the distribution of nucleated settlements. The general distribution of population in its turn is conditioned to a certain extent by the physical features of the county. While hamlets will continue to lag functionally and disappear, it is likely that the growth in populations and functions of urban centers and semi-urban centers of Lewis County will proceed only at a moderate pace, for these urban and semi-urban centers themselves have become tributary to the cities of Watertown and Rome, lying outside the county. 322 pages. $4.03. MicA 55-1070

1. By nucleated settlement for the purpose of this project is meant a settlement that contains at least five residential buildings and at least one commercial, institutional, or industrial building, grouped within one-quarter of a mile (linear distance).

AGRICULTURAL LAND USE IN CAYUGA COUNTY, NEW YORK. A QUANTITATIVE STUDY OF THE DEGREE OF COINCIDENCE IN DISTRIBUTION BETWEEN AGRICULTURAL USES OF LAND AND PHYSICAL LAND TYPES.

(Publication No. 11,879)

Maung Pe Thaung, Ph.D.
Syracuse University, 1955

The aim of this thesis is to examine in Cayuga County, New York the areal associations of present agricultural land uses with the underlying qualities of the land, and to look for discrepancies and accordances of land use and terrain. We hope that the results of this project may throw some light on the changes and the resultant problems of agriculture in the county.

The study involves the investigation of two interrelated sets of phenomena: (1) Agricultural land uses, and (2) the physical characteristics of the land used. The interconnections between the two sets of phenomena are established through the operation of the farmer and his area of operation is the farm unit. The uses of the farm unit are determined by the objective and the attitudes of the farmer in alignment with the changing economic conditions.

The procedure of this study involves two methods of approach: (1) A study of the whole county on a generalized scale. This is based on topographic sheets, air photos, soil map, weather reports, published writings and statistical data of U. S. Census of Agriculture. Major land-use and land-type areas are

defined. The following aspects of agricultural occupance are considered and related to physical land conditions; major uses of farm land, pattern of farm settlement, changes in agricultural land use, and present types of farming. (2) A selection of three sample areas representative of the major physical divisions of Cayuga County. Field study is conducted in each of these sample areas by field mapping of unit areas of terrain and land use, field notes, pictures, and interviews. From the data of this fieldwork and observations five maps are prepared for each sample area on a scale of 4 inches to a mile to show:- land units, land types, uses by fields, uses by type areas, and finally a map on which land types and land uses areas are superimposed. Farms and farming types in each sample area are also examined.

Our findings as the result of this study may be summarized as follows: (1) The areal distribution of major uses of farm land is distinctive in each land type of Cayuga County. (2) The kind of crops grown and the methods of farming have close relationships with the slope-soil-drainage complexes. (3) Farm holdings in Cayuga County occupy in most cases more than one land type. This is most common in the Northern Drumlin and the Southeastern Upland Regions. (4) The types of farming carried on in Cayuga County have areal associations with the land types. Dairying is the most important enterprise in all land types while the secondary enterprises have been closely adjusted to the prevailing local physical conditions of the land. (5) Changes in agricultural economy have brought about problems in land use, such as abandoned farms and neglected orchards. These farm and fruit orchards occupy productive farm lands and they have been abandoned purely because of social and economic factors. However, submarginal farms are located in areas where the land resources are poor. (6) Adjustments in land use – land type relationships have been going on in Cayuga County – draining of wet lands, rotation of crops, crop associations, methods of farming, afforestation of steep lands, and the use of fertilizers. The degree of success in land use – land type adjustments is not the same in all parts of the county, so that there are differences in farm income, crop yields and the general level of living of the farming community in Cayuga County.

266 pages. $3.33. MicA 55-1071

GEOLOGY

DEVELOPMENT OF THE LITHOFACIES MAP AND ITS PRACTICAL APPLICATION TO EARTH MATERIAL: BORROW AREA INVESTIGATION

(Publication No, 11,865)

Winthrop C. Difford, Ph.D.
Syracuse University, 1954

The purpose of the paper is two fold. Because lithofacies maps are relatively uncommon in the literature, it is first shown what they are, and how they are classified, prepared, and interpreted, with examples cited from the literature.

For study, five areas, representing sand, gravel, loess, glacial moraine, and alluvium, were chosen from the writer's field experience during his employment by the United States Bureau of Reclamation in Nebraska and Colorado. Practical use of ratio, percentage, and isolith maps, and variations of the fundamental lithofacies triangle, developed by earlier workers as a means of contrasting two ratios, are developed. These ratios include a fluvial ratio and a sediment ratio.

Twenty-two maps and sections and six tables are included. The selection of maps was controlled by the particular details of each area and by the availability and quality of drill records.

A suitable grid is suggested to replace the one presently recommended by the Bureau of Reclanation for investigation drilling of borrow areas. Ten to eighteen holes are satisfactory for most areas.

Available quantity of material in a borrow area can be more readily calculated from isolith maps than from cross sections or topographic maps.

It is natural that the investigation of borrow areas should be one of the more important applications of geology to earth material construction. Field investigations are expensive operations. Incomplete information may be expected unless the geologist has the tools and equipment with which to produce reliable, economical, and adequate information in the best possible time.

The lithofacies map, properly applied, can become an important "tool" to the geologist engaged in material investigations. The maps can furnish more reliable and complete information with a savings in time and money over present investigation methods.

A series of maps for any interval gives better three-dimensional implications than earlier cross sections supplied. In the above mentioned ways, the lithofacies map may be considered ideal for use in earth material borrow area investigation.

107 pages. $1.34. MicA55-1072

THE UPPER MISSISSIPPI VALLEY ZINC-LEAD DISTRICT. In two parts: I. GENERAL STRUCTURAL RELATIONS OF THE UPPER MISSISSIPPI VALLEY ZINC-LEAD DISTRICT II. THE ORE DEPOSITS OF THE UPPER MISSISSIPPI VALLEY ZINC-LEAD DISTRICT

(Publication No. 10,920)

Allen Van Heyl, Jr., Ph.D.
Princeton University, 1950

The Upper Mississippi Valley zinc-lead district comprises an area of about 2,500 square miles consisting of the southwest part of Wisconsin, the northwest corner of Illinois, and a part of the northeast edge of Iowa. The Paleozoic rocks, from upper Cambrian to Silurian in age, consist of slightly deformed lower Paleozoic dolomites, limestones, sandstones, and shales, forming a thin veneer of sediments upon a buried, pre-Cambrian shield basement. The principal ore bodies were deposited in the middle Ordovician Galena, Decorah, and Platteville formations. The lead ore, principally galena, occurs in vertical joints in the Galena formation. The larger zinc ore bodies have been deposited in the lower Galena, Decorah, and upper Platteville formations along minor fault zones.

The area is southwest of the Wisconsin dome and lies west of the Wisconsin arch. The district forms a salient between the Illinois basin to the south, and the Forest City basin to the west and southwest. The regional strike within the district is approximately N. 85 W., and the dip to the south is about 18 feet to the mile. Three major anticlinal flexures of from 100 to 200 feet in amplitude cross the district in a general westerly direction. The northernmost of these folds has a northeasterly trend in the east part of the district and a northwesterly trend in the west part of the district. All three anticlines are asymmetric with steeper north limbs.

Most of the smaller folds have axial trends falling into two general groups, bearing easterly and northwesterly, forming an intricate pattern of cross-folding. These lesser folds are generally elliptical in outline forming a series of gentle dome and basin flexures. The intensity and magnitude of folding decreases from the south to the north part of the district.

Major faults, consisting of both reverse and shear faults, are rare and traced with difficulty.

The smaller, subsidiary folds are especially important in relation to the smaller faults, and to the ore deposits of the district. The smaller faults and related ore bodies conform closely to the fold patterns. All the zinc ore bodies are localized in fractured zones consisting of bedding-plane and reverse faults on the flanks of the folds where the belding dip is at a maximum. The reverse faults, which rise from bedding-plane faults in the incompetent Decorah formation, have from one to ten feet displacement. Most of the reverse faults dip into structurally nigh areas, are commonly mineralized, are traceable for great lengths along their strike, and often swing in arcs around the ends of the folds.

The joints tend to fall into three groups: (1) easterly-trending tension joints, often mineralized; and (2) northeasterly – and (3) northwesterly-trending, shear joints, forming a shear pair bisected by the plane normal to the dominant easterly fold trend.

From the general pattern, the deformation in the Upper Mississippi Valley mining district was the result of a regional, tangential, compressive force which was resolved into two somewhat unequal components. The more active and important component was developed northward into the district by the compression of the Illinois basin, while the second, less-active force component was developed by the simultaneous compression of the Forest City basin acting northeastward into the district. The age of the deformation was presumably in late Paleozoic times.

The mineralogy of the ores is relatively simple. The known primary minerals include gold, galena, sphalerite, wurtzite (?), millerite, chalcopyrite, pyrite, marcasite, calcite, dolomite, ankerite, quartz, barite. Sphalerite, marcasite, and sometimes pyrite and marcasite are often in layered masses, or in concentric, mammillary nodules of radiating crystals suggesting colloidal precipitation.

Widespread solution, silicification, and dolomitization has taken place within the ore deposits and in their immediate vicinity altering particularly the calcareous wall rocks.

The minerals have been deposited in a regular sequence of deposition, commencing with silca and dolomite, and then the sulfides and ending with barite and calcite. The solution of the wall rocks is essentially contemperaneous with ore deposition. Deformation was prevalent previous to ore deposition, continued in a series of weaker pulses during ore deposition, and it ceased at approximately the end of the ore-depositing period.

Vertical and horizontal zoning both regionally and locally are recognizable and characteristic features of the ore deposits of the district.

The best available evidence suggests that the ore deposits were deposited by rising telethermal solutions with temperatures not exceeding 100 degrees centigrade. 303 pages. $3.79. MicA 55-1073

GEOLOGY OF THE NORTHERN BLACK HILLS BENTONITE MINING DISTRICT

(Publication No. 11,524)

Sam Hunting Patterson, Jr., Ph.D.
University of Illinois, 1955

The bentonite beds of the northern Black Hills are in rocks of Cretaceous age, which include marine shale, marl, and argillaceous sandstone and some shallow water and beach deposits. Tertiary and Quaternary rocks are represented in the district by extensive terrace deposits and alluvium. Rocks containing the nine bentonite beds investigated are 3,100 feet thick and range from the Newcastle sandstone to

the lower part of the Mitten member of the Pierre shale. Large bentonite reserves are present, because the rocks containing the bentonite are brought to the surface repeatedly by many low anticlines. Two of the important beds rest on resistant strata and are overlain by thin cap rocks. These cap rocks form local dip slopes under which the bentonite lies at shallow depths.

Montmorillonite is essentially the only clay mineral present in the bentonite. Sodium bentonite is most common in the lower part of the Upper Cretaceous and in Lower Cretaceous rocks. The Clay Spur bed and bed D contain the bentonite that is richest in sodium. These two bentonite beds are within a few feet of the Mowry-Belle Fourche contact, the boundary between the Upper and the Lower Cretaceous. Calcium bentonite is coextensive with the sodium type, and in addition occurs in much younger strata. Calcium is essentially the only exchangeable ion in beds B and I. Bentonite beds are enclosed by rocks representing several different conditions of deposition. The presence of both calcium and sodium bentonite in beds that were deposited in different environments suggests that exchangeable ion characteristics were not influenced by conditions of deposition but are probably related to the composition of the parent material of the bentonite. The importance of the composition of the parent material is also suggested by deposits of both calcium and sodium bentonite in rocks representing a single condition of deposition and identical post depositional histories.

Sodium is the dominant exchangeable ion in the important Clay Spur bed and in beds A and D, but calcium, magnesium, and hydrogen ions are present in varying amounts. Bentonite under more than a few feet of overburden is bluish gray and has much lower colloidal properties than discolored clay near the surface. Apparently the natural water content is in rather stable equilibrium with the clay. The equilibrium is chiefly influenced by the exchangeable ions in the montmorillonite, and where sodium is essentially the only ion present colloidal properties are increased by either a natural or induced ion exchange whereby some of the sodium is replaced by other ions and the equilibrium is disrupted. Ion exchange takes place near the surface during weathering which alters the bluish gray bentonite to olive green and yellow.

Relationships of thicknesses of the Clay Spur bed and enclosing strata indicate that deposition took place on an undulating surface with a relief of at least 12 feet. Varvelike interlaminated light and dark colored bentonite in the upper part of the Clay Spur bed represents seasonal deposition.

152 pages. $1.90. MicA 55-1074

HEALTH SCIENCES, GENERAL

STUDIES ON INFLUENZA VIRUS PROPAGATED IN EMBRYONATE EGGS: CHARACTERIZATION OF VIRUS PRODUCED AFTER INOCULATION OF DILUTE AND UNDILUTED SEED

(Publication No. 11,295)

Jacob Charles Holper, Ph.D.
University of Michigan, 1955

The purpose of this study was to characterize and compare quantitatively the virus produced in embryonate eggs following inoculation of dilute (standard passage) and undiluted (undiluted passage) seed. The virus yield of standard passage is infectious and agglutinates red cells whereas undiluted passage virus, which agglutinates red cells equally well, has a significantly lower infectious titer. Since standard and undiluted passage virus contain a mixture of different viral particles, quantitative methods were used whenever possible to determine the relative concentration of the various viral components.

Heat-labile 700 S component. Previous workers have described two components in undiluted passage suspensions: (1) a virus particle with a sedimentation constant of approximately 500 Svedburgs (S); and (2) a 700 S component. Studies on the rate of inactivation of undiluted passage virus have indicated that a portion of the 700 S virus may be very heat-labile. The approximate percentage of each component in the first passage of undiluted seed was found to be as follows: 40 to 60 percent 500 S component; 40 to 60 percent heat-labile 700 S virus; and one percent stable 700 S component.

Similarities between standard and undiluted passage virus. Studies on the properties of influenza virus suggest that 700 S and 500 S components have very similar surface structures. For example, standard and undiluted passage virus could not be differentiated on the basis of: (a) hemagglutination of red cells from various species of animals, (b) antibody combining capacity and production of antibody in rabbits and mice, (c) development of the indicator state, (d) prevention of the indicator state with calcium. Furthermore, equal proportions of standard and undiluted passage virus were irreversibly adsorbed to the chorio-allantoic membrane of deembryonate eggs.

Dissimilarities between standard and undiluted passage virus. (a) Undiluted passage virus had less enzymic activity than standard passage virus as

measured by inactivation of inhibitor or elution from red cells. The eluting capacity further decreased with serial passage of undiluted seed. (b) Non-infectious hemagglutinin of undiluted passage virus either lacked completely or possessed a minimal amount of the capacity for interference with multiplication of Lee virus in embryonate eggs or interference with toxicity of PR8 in the mouse brain. (c) Infective virus in undiluted passage suspensions interfered less than standard passage infective virus with the growth of Lee virus. This decreased interfering capacity of undiluted passage infective virus is thought to be due to the production of non-infective virus (which lacks the capacity to interfere) following inoculation of undiluted passage virus into eggs. (d) Studies on the toxicity of undiluted passage virus indicated that a portion of the infective virus was non-toxic. Hence, a lack of correlation between infectivity and toxicity in undiluted passage virus suspensions may be inferred.

Studies on the mechanism of inhibition of agglutination by egg-white inhibitor have shown that heated virus forms an irreversible complex with inhibitor. Enzymatic destruction of inhibitor does not explain the failure of egg-white to inhibit unheated virus. Inhibition of unheated virus is probably dependent upon the relative concentration of erythrocytes to inhibitor.

In conclusion, evidence was found of a third component in undiluted passage virus suspensions. Studies on the properties of the various viral components have suggested that surface constituents of the viral particles are similar. However, a portion of undiluted passage virus is thought to be lacking in characteristics resultant of intracellular reactions.

119 pages. $1.49. MicA 55-1075

HISTORY

HISTORY, GENERAL

A HISTORY OF THE LIBRARY COMPANY OF PHILADELPHIA, 1731-1835

(Publication No. 11,410)

Dorothy Fear Grimm, Ph.D.
University of Pennsylvania, 1955

Supervisor: Robert E. Spiller

The Library Company of Philadelphia, founded in 1731 by Benhamin Franklin and his fellow members of the Junto, was the first subscription library to be established in the colonies. The idea spread throughout the colonies until there were 806 libraries of this type organized along the eastern seaboard. These libraries contributed in a large measure to making the American farmer nearly as well read as an English gentleman.

Though the majority of these libraries were not able to survive for many years, the Library Company of Philadelphia has continued to operate in the same manner for more than two centuries. One reason for its continuous and for the most part prosperous existence has been a result of unusual good fortune in every respect. Unlike most of the other libraries, the Company withstood the trials of wars, depressions and plagues without serious damage. While other libraries were destroyed either by fire or lack of interest, the Library Company continued to flourish even in difficult times through the unstinting efforts of its directors. The hetergeneity of the religious and political beliefs of its managers always assured it of having some members on the board who were concerned about the library's welfare whether Philadelphia was occupied by the British or the American army. This same mixture of politics and religions served as an aid in building up a well-balanced collection of books, thus meeting the needs of a wide variety of readers.

This study of the Company traces the library's history through the times of its greatest growth and influence. It is a study not only of an organization but also of the country. The changes in administrative policies reflect the events in American history in general and in Philadelphia history specifically. The development of library techniques from the most casual to something resembling a science is also seen in following the Company's development.

Not only was the Library of importance as a book collection, but also for its secondary aspect of a museum of curious natural objects and expensive scientific equipment; the former provided by interested citizens and the latter largely through the generosity of the Penn family. The museum, open free-of-charge to everyone, served also as a lecture room where the Philadelphian could attend series of talks on electricity, the power of the air and like subjects. Thus the age of experimentalism and science which was sweeping Europe was brought home to the Philadelphians.

The history shows that though other libraries were started in Philadelphia, they did not present themselves as serious rivals to the older company. The Library Company continued to grow while the other libraries ran their courses and were in the end assimilated by the original company. The Library Company was enriched not only by the mergers of the newer groups but also by the annexation of the private library of James Logan, consisting of several thousand volumes of the classics.

The various catalogues of the Company are evaluated and to some degree analyzed to show the changes

in reading trends from the first shipment of forty books, largely in the field of science, to the Catalogue of 1835, consisting of more than one thousand pages, with emphasis on the literature and history sections. This change in reading interests showed how the Company had grown from a research library for the Junto to a collection approximating a public library for a sizeable portion of the city.

367 pages. $4.59. MicA 55-1076

WILHELM DILTHEY AS HISTORIOGRAPHER

(Publication No. 11,462)

William Kluback, Ph.D.
Columbia University, 1955

Wilhelm Dilthey set himself the task of writing a critique of historical reason. He wished to submit the historian's procedure to an epistemological examination as Kant had previously examined the procedure of the mathematician and natural scientist. From his historical study Dilthey became aware of the limited nature of every historical occurrence, be it a religion, an ideal or a philosophic system. According to him man, by nature has to express himself. Those expressions that are recorded, form the universal historical stream. This stream becomes man's cultural environment, and it helps to shape his further thoughts. Life expression not only determines the future course of history, but is in turn molded by the past.

Out of this historical process evolves the history of ideas. Ideas are the expression of the mind of man in contact with life. Every idea is limited and at the same time given meaning by its place in the universal-historical continuum. Because ideas are a reflection of both the eternal nature of man and of the life situation in history, they are the key to the understanding of the historical world. As an expression of the interaction of mind and environment throughout history, the history of ideas furnishes the dynamic structural unity of life. The history of ideas is the cement of the historical world; it furnishes the empirical foundation for a critique of historical reason.

Although Dilthey regards the comprehension of the historical stream as the final goal of historical understanding, he returns always to the individual symbolic work as the point of departure. An understanding of the individual work is possible only through trained intuitive insight. The processes of the natural world can be halted for purposes of investigation and studied in laboratory conditions. This is impossible with the historical stream, for only an intuitive insight can grasp the stream of a constantly changing history in its symbolic development.

For Dilthey, the task of the historian is not mastered by intellect alone; it requires, rather, a constant cooperation of the creative imagination, which alone can unify isolated and widely dispersed facts. The historian's imagination does not strive to transcend reality. It subordinates itself to experience and to the investigation of what is real. History, therefore, is not a special province but the whole of reality. All history is contemporary history; thus history and philosophy become one. There is no realm of being, no other subject matter for philosophical thought beyond the human realm of history.

Dilthey represented in the second half of the nineteenth century the efforts made by German historical scholarship to free itself of positivism. While his contemporaries believed that they possessed objectivity in documentation, he sought the criteria of certitude in the mind. Consequently, when the naive faith in the Tatsache subsided, he appeared as a savior to those who refused to yield to the whims of subjectivism.

Dilthey's great contribution to the history of thought is the demonstration that through historical understanding man becomes conscious of the totality of all human experience. He succeeds in proving that only the historical conscious mind can comprehend all philosophical systems. The historian sees the partial truth of all intellectual expressions. Dilthey attempts to give structure to history within the framework of three recurrent world-views. Life, however, he believes transcends all philosophical structures; it escapes all limitations; it cannot be fixed.

168 pages. $2.10. Mic 55-98

THE HISTORY OF THE FORMER YEN DYNASTY (285-370)

(Publication No. 11,469)

Gerhard Schreiber, Ph.D.
Columbia University, 1954

The Former Yen Dynasty (Ch'ien Yen 前燕) was the first of a series of dynasties imposed on Northern China by chieftains of the Hsien-pi people. From the time of the Later Han Dynasty (A.D. 25-220) the Hsien-pi had constituted a constant threat to the Chinese Empire. From their homeland in Manchuria they invaded Chinese territory marking their way by plundering, killing and burning.

In the third century a group of Hsien-pi, ruled by the Mu-jung family, accepted Chinese culture and customs and started a vassal state inside the boundaries of China. This little state around the head of the Gulf of Liao-tung became the sanctuary of thousands of Chinese refugees, when the Central Provinces of China were plunged into a series of exceptionally cruel civil wars which were climaxed by the loss of Central China to the Hsiung-nu who conquered the two capital cities Lo-yang and Ch'ang-an, dethroning and executing the Chinese emperor Huai.

With the help of these Chinese refugees the Mu-jung were able to enlarge their state by conquest of their non-Chinese neighbors. Moreover, when the Empire of the Hsiung-nu crumbled after the death of Shih Hu, the Mu-jung assisted by their Chinese officials and soldiers pushed their boundaries towards the South and West into what is called today Kiangsu, Anhwei, Honan, and Shensi. The Mu-jung ruler, now

lord of the Central Provinces of China, called himself Emperor of China. However, under the second emperor the dynasty came to an end. The state became so weakened under the incompetent rule of the Emperor's uncle, acting as regent, that the armies of the Tibetan Fu Chien, who had himself established in the West when the Hsiung-nu Empire had disintegrated, easily overran and conquered the Mu-jung.

377 pages. $4.71. Mic 55-99

IGNAZ von DÖLLINGER: A STUDY IN CATHOLIC HISTORICISM

(Publication No. 11,547)

Stephen John Tonsor, Ph.D.
University of Illinois, 1955

Although Ignaz von Döllinger (1799-1890), was one of the most important figures in the Catholic revival of the nineteenth century, he was also a historian of importance whose interpretations of church history were highly regarded in his day. However, in his old age he exchanged his priesthood in the Roman Catholic Church for the "priesthood of science" – a phrase he often used – and now he is recalled, if at all, as the heretic who defied the decree of 1870 proclaiming papal infallibility.

Previous studies of German historical writing have tended to emphasize the North German, Protestant schools and to neglect the contributions of the South German Catholic historians. Moreover, students of the life of Döllinger have tended to emphasize his role as a religious controversialist rather than his role as a political thinker and historian. A study of Döllinger's early years, emphasizing his work as a historian rather than his work as a theologian, may therefore prove valuable.

A most important source of this study of the life and development of Döllinger is the collection of Döllinger's personal papers in the Bavarian State Library in Munich, Germany. Equally important to this study was a careful reading and analysis of his printed works. Especially valuable are the journalistic writings of Döllinger which appeared in the Munich newspaper, Eos between 1826 and 1835. Until now these writings have never been given the careful study they deserve. In addition to these sources, the extensive notes which Lord Acton (1834-1902), student and intimate friend of Döllinger, made preparatory to a biography which was never written, constitute a hitherto unused source of material concerning the great man. These notes were obtained from the Acton manuscripts found in the Cambridge University library.

The study reveals a religious and political conservative. He adopted the revolutionary techniques introduced into historical study in the early nineteenth century only when he was forced to by aggressive North-German, Protestant Scholarship. He accepted the new techniques because he felt he could, by changing his methods, protect his principles. Developments in both State and Church, meanwhile broke with what Döllinger considered the heritage of the past and rather than sacrifice his principles Döllinger became a schismatic. While the effect of his work upon the development of the State and the Church was ephemeral his influence upon historical thinking within the Roman Catholic Church was enduring. Despite the monumental strivings of Pius IX and Pius X, the Catholic Church has not been able completely to unlearn his lessons.

192 pages. $2.40. MicA 55-1077

HISTORY, MEDIEVAL

THE EMERGENCE OF PRINTING AND PUBLISHING AS A TRADE, 1450-1550

(Publication No. 11,413)

Rudolf Hirsch, Ph.D.
University of Pennsylvania, 1955

Supervisor: Professor Kenneth M. Setton

The explanation of the particular time and place of the invention of printing must be sought not in the technical or intellectual, economic or social sphere, but in the favorable combination of all four elements. Interest in reading on the part of a sufficiently broad segment of the population, their leisure, economic strength and a degree of stability, technical progress and the development of literate craftsmen had all to be present to assure the success of the invention. Printing and publishing were the first important trades to develop outside the traditional pattern of the mediaeval guild system. The absence of guild regulations and the need for an uncommon combination of skills wanted in the new profession helped to attact an amazing variety of men (and some women); we find among them metal workers, scribes, artists, the low and the high clergy, students and teachers, as well as patricians and noblemen.

Since early printing and publishing faced problems distinct from those of the traditional producer of books, the scriptorium, and since no near-parallel existed with any other trade or craft, the selection of texts to be printed, their production, and the marketing of quantities of books had to be evolved through a process of experimentation. The acquisition of type fonts, the construction or purchase of presses, the purchase of paper and the training and employment of qualified labor required a sizable capital. In spite of these difficulties printing spread rapidly and successfully, attesting to the ingenuity of early printers and to the need for multiple copies of identical texts. The printed book, though still expensive, was between 75 and 80 percent cheaper than the comparable manuscript. Prices of books fell as production increased and competition mounted until books had become a stable commodity by the end of the sixteenth century; from then on they follow the general price fluctuation of other merchandise.

Practically all the legal and quasi-legal concepts met with in modern publishing are rooted in the early

history of the printing and publishing trade. The increase of reprinting led to the privilegium which is the predecessor of the modern copyright. Press laws and controls, now applied to prevent abuse, have their origin in censorship regulations which go back to the 1470's. The religious and political struggles of the Reformation led to a "refinement" of censorship; printing had become a recognized tool of propaganda; to influence and control, as far as possible, public opinion, it was necessary to make full and good use of the printing press.

The spread of printing through various parts of Europe indicates, to some extent, the literacy of specific regions. However, great density of printing places in one territory, or the absence of facilities in another, are not a priori evidence of the state of literate culture. The printing history of individual texts serves to measure the popularity of specific writings or groups of literature; it is an index of literary taste. The same text was not reprinted, surely not in the same locality, unless an active demand existed for more copies. Closer scrutiny seems to prove that we have underestimated the interest of northern readers in the writings of classical, and particularly of humanist, authors.

Printing affected trends in language and literature. The transition from reading aloud to silent reading was accelerated by the invention of printing. Increased production of books helped the spread of literacy. The marketing of sizable editions of vernacular texts beyond clearly defined dialect areas favored the progress of national written languages (Schriftsprachen) and led to the decline of dialect literature. Literary forms and styles meant primarily for recitation lost ground while those better adapted to silent reading, like dialogues, gained in importance.

Printing meant the decline of the typical mediaeval folio codex and the corresponding increase in the number of thin quartos and handy octavos; the issuing of innumerable news sheets, often in the form of broadsides or posters; the cheapening of paper and the gradual disappearance of the multitude of highly individualistic type faces (the book hand of the manuscript period); the triumph of pagination and the carefully planned index which, in turn, made possible exact citations; and the development of the title-page as an advertising medium.

We witness a weakening of local and regional characteristics, in favor of national styles, in language and literature, typography, book illustration and binding. 194 pages. $2.43. Mic 55-100

THE CHRONICLE OF MOREA: A TRANSLATION WITH NOTES AND INTRODUCTION

(Publication No. 11,420)

Harold E. Lurier, Ph.D.
University of Pennsylvania, 1955

Supervisor: Kenneth M. Setton

The Chronicle of Morea, an indispensable source for the history of the Frankish states in Greece during the 13th century, survives in four versions in four languages and eight manuscripts. There are a French, an Aragonese, an Italian, and five Greek texts. Of the Greek manuscripts, the best and earliest is the Codex Havniensis 57 in the Fabricius Collection of the Library of the University of Copenhagen, which was published in a fine edition by John Schmitt in 1904 and most recently in 1940 by Petros P. Kalonaros. This dissertation is a prose translation of the manuscript, based on these two editions.

The Chronicle consists of a prologue, describing inaccurately the events of the First and Fourth Crusades, and the main text, which is an account of the history of Frankish Greece from 1204 to 1292. There are frequent muddled descriptions of events in contemporary Italy, Epirus and Nicaea, as well as interpolations of later events.

The Chronicle deals principally with the fortunes of the Villehardouin family and gives an elaborate description of the military operations under the first four princes of Morea, with greater emphasis placed on those of Guillaume II de Villehardouin. Great attention is given to deliberations of the High Court, the distribution of fiefs and the establishment of a Frankish feudal system, and the relations with the native Greeks.

There are scores of allusions to persons and places, some of which are fairly obscure; all of these have been identified as accurately as possible in the footnotes. Here, there also appears a detailed running correction of the historical inaccuracies and confusions of the text.

The most perplexing problem connected with the Chronicle of Morea has been the question of its origin. Which of the four versions is the original? What is the relation between them? When were they written? etc. These questions and the theories of scholars in the field are discussed in the Introduction, which offers a new interpretation. Based on a critical analysis of the language and style of the Greek text and a comparison of it with the other versions, it is suggested that an original chronicle, written in French sometime between 1304 and 1314, and now lost, served as a prototype for the existing versions. The French version appeared as an abridgement of the original sometime between 1332 and 1346, and most probably between 1333 and 1341. The Greek version, in turn, appeared as a translation of the French original shortly before 1388. In 1393, an expanded Aragonese translation of the French abridgement was made, and at various later times five other editions of the Greek translation appeared, including an Italian translation.

The language of the Greek version presents a curious problem to a translator. The vocabulary is a mixture of classic and medieval Greek words and many others borrowed from Italian and French. The grammar reflects in Greek the same sort of development that Latin went through as it became the Romance languages of the Middle Ages. The Greek version is, however, an intriguing example of the vernacular Greek literature of the period. This translation has attempted to retain as carefully as possible the flavor of the original.

The Chronicle of Morea is not important only as a principal source for the political and military history of 13th century Greece, but even more so as a vivid picture of the social manners and customs of the Franks and Greeks of the period. It offers illuminating details of court procedure, dress, speech, castle life, feudal obligations, fighting techniques, etc., which weave a rich tapestry of feudal life in the 13th and 14th centuries.

431 pages. $5.39. MicA 55-1078

TALLEYRAND DE PÉRIGORD (1301-1364), CARDINAL BISHOP OF ALBANO

(Publication No. 11,446)

Norman Peter Zacour, Ph.D.
University of Pennsylvania, 1955

Supervisor: Kenneth M. Setton

This is a study of the career of an Avignonese cardinal, Elie Talleyrand, third son of Count Elie VII Talleyrand de Périgord. I have attempted to show that Talleyrand's rapid rise in the church (he became a cardinal at 30) owed most to the support of the French crown. Périgord was a crucial area in the long drawn out struggle between the French and English in Guienne and Gascony, and the undeviating support of the French crown by the counts of Périgord guaranteed in turn the support of the young Talleyrand by the king of France at the very time the popes, lately established at Avignon, were extremely sensitive to the pressures of the French crown.

Talleyrand's duties as a cardinal – to be exact, the specific cases involving him in the capacity of negotiator or judge on behalf of the papacy, or as mediator at the curia for some private person – have been examined, as well as the growth of his influence in the curia, indicated by the increasingly important role he played in the elections of Benedict XII, Clement VI, and Innocent VI. As a cardinal, Talleyrand came to know well the poet Petrarch, whose correspondence has been examined at some length for the light it throws on the cardinal's character, to say nothing of his ignorance of classical literature or of what constituted a good Latin style.

Talleyrand's support of his relatives in Naples, the Durazzeschi, has been described, from the time of Joanna I's accession in 1343, as well as his hostility to the Neapolitan court after Louis of Taranto became king. This in turn explains his support of his nephew Robert of Durazzo who seized the Provençal fortress of Les Baux in 1355. Talleyrand's alleged complicity, however, in Arnaud de Cervole's invasion of Provence in 1357 seems to be unfounded.

I have dwelt at some considerable length on Talleyrand's mission to France and England in 1356-59, not only as an episode in the Hundred Years War, but as a phase in the growing anti-papalism in England and an aspect of the problem of papal control of the church in England, which Talleyrand, negotiating peace between the French and English, also had to deal with. I have devoted some space, finally, to a description of the rivalry in the curia between cardinal Guy de Boulogne and Talleyrand, which came to a head in 1362 when both cardinals were candidates for the papal throne – a rivalry which lay behind the complicated negotiations for the hand of Talleyrand's grandniece Joanna of Durazzo, whom Guy hoped to marry to his own nephew Aimon III of Geneva. Until Talleyrand's death in January 1364 he succeeded in holding Urban V on his side in this matter, although immediately after Talleyrand died Urban fell under the influence of Guy.

The work concludes with a description of Talleyrand's taking the cross in 1363 in company with John II of France (he was not to go on crusade), his foundation of the college of Périgord in the University of Toulouse, his last will and testament (indicating his immense wealth), and the evidence respecting his last resting place. 289 pages. $3.61. MicA 55-1079

HISTORY, MODERN

THE UNDERWOOD PRESIDENTIAL MOVEMENT OF 1924

(Publication No. 11,390)

Lee Norcross Allen, Ph.D.
University of Pennsylvania, 1955

Supervisor: Roy F. Nichols

The Underwood Presidential Movement of 1924 is a study of the extensive campaign of one man, Senator Oscar W. Underwood of Alabama, to gain the Democratic nomination for President in 1924. It is a record of the organized efforts made by him and his friends to enlist support among the electorate and the delegates to the nominating convention. In brief it also surveys the pre-convention activity of the other major candidates. A description of the 1924 Democratic convention held in New York City is included in the work.

Prevailed upon by close friends and admirers in Alabama and elsewhere, Underwood affirmatively in July, 1923, responded to the request of the Alabama Legislature that he become an avowed candidate for the Presidential nomination. His intention was to enter the national convention with the united backing

of the traditional Solid South. Campaign headquarters were opened in Montgomery, Alabama, and Washington, D. C., to direct the open primary campaigns in Alabama, Georgia, Texas, Tennessee, Mississippi, and Florida, and to work quietly for favorable sentiment in the remainder of the nation.

As the campaign developed, Underwood alienated the recrudescent Ku Klux Klan by assaulting its un-American proscription of religious freedom and its secret control of government. Early in the campaign he espoused a platform plank that would censure the Klan by name. The strength of the growing hooded order in the South was turned against him, and in every state except Alabama he was badly defeated. The only compensation for him was the random support that rallied to his standard in some of the northern anti-Klan states.

By the time the convention met in June, Underwood had diminished to the status of a favorite son candidate. His strategy at the prolonged New York meeting was to work for favorable sentiment among delegates who would turn to him as their second choice. William G. McAdoo and Alfred E. Smith deadlocked the convention through ninety-nine roll calls. On the four remaining ballots as the exhausted delegates groped for a winner several compromise candidates were pushed forward. Underwood was one of them. However, the antagonisms he had aroused by his anti-Klan declarations caused the delegates to turn to John W. Davis on the one hundred third ballot.

The study of the Underwood campaign of 1924 is based on the voluminous and revealing correspondence accumulated by his national campaign committee and now deposited in the Alabama Department of Archives and History at Montgomery. To draw Underwood into the proper perspective and to furnish further background material, the manuscript collections of other leading Democrats have been searched. Among them the most helpful were the papers of Newton D. Baker, William J. Bryan, Josephus Daniels, Carter Glass, and Thomas J. Walsh. The two most frequently used newspapers were the Montgomery Advertiser and the New York Times. All known biographies and autobiographies of Democratic leaders of the day have been examined. And several men active in politics of that year were visited or contacted by mail.

The study begins with a survey of the Democratic position in the early 1920's and is followed by a group of brief chapters on campaign affairs state-by-state and concludes with an analysis of the 1924 Democratic convention and an evaluation of the Underwood campaign. 308 pages. $3.85. MicA 55-1080

THE RHINE PROBLEM DURING THE SECOND REPUBLIC AND SECOND EMPIRE

(Publication No. 11,394)

Paul Bernstein, Ph.D.
University of Pennsylvania, 1955

Supervisor: Lynn M. Case

This study deals with the French quest for a more tenable Rhenish frontier during the middle of the nineteenth century. The investigation of this problem covered the period 1848 to 1870 in order to include the many fluctuations in French policy under Louis Napoleon Bonaparte. Particular attention has been devoted to the years 1848-1863, since little research on the Rhine question has been done for that period.

Source material used for this study includes extensive research in the State Department Correspondence at the National Archives. At the Library of Congress, the Maximilian Archiv, Aberdeen Papers, and Hotze Papers were consulted. The Massachusetts Historical Society and New York Public Library allowed the author to use the Bancroft Papers. The latter institution also permitted the use of the Bigelow Papers. In addition, all of the standard documentary collections of the European governments were used as well as a large number of printed diaries and memoirs.

The results of this dissertation indicate that:

1. The Rhine policy of France fluctuated widely from 1848 to 1870. Her demands ranged little Luxemburg to the entire left bank of the Rhine.
2. The industrial inferiority of France seemed to play a larger role than previously suspected in the formulation of her Rhenish policies.
3. The growing power of public opinion was one of the instrumental factors behind the Rhine policy of France, particularly after Sadowa when it demanded compensation for the gains of Prussia.
4. The emergence of a new national state in Germany gave the French a reasonable basis for their territorial claims after 1866. This was the need to preserve the balance of power.
5. The traditional French desire for expansion toward the Rhine was part of an historical pattern spanning many centuries.
6. The French failure to secure a better eastern frontier was due to a) Her inability to obtain a lasting alliance b) The indecisive policy of France after Sadowa c) The military weakness of France d) The perversity of French public opinion after 1866 which demanded compensation, but refused to sanction the military reorganization France needed.

As a general conclusion we may say that the Rhine policy of France fell into two fairly distinct periods during the middle of the nineteenth century. For the years 1848-1866 France pursued a more "offensive" quest for expansion, that is, she sought to enlarge her territory more to efface the 1815 treaties than to meet any real military threat in Germany. From 1866 to 1870, the French pursuance of compensation along the Rhine, in Belgium and Luxemburg was more "defensive" and hence more legitimate. Her demands were formulated to meet the great military and industrial power of an expanding Prussia. As such, the French aspirations after Sadowa were made to preserve the European balance of power. It is this shift in emphasis that forms the basic conclusion of the dissertation. 393 pages. $4.91. Mic 55-101

PENNSYLVANIA COAL: AN HISTORICAL STUDY OF ITS UTILIZATION TO 1860

(Publication No. 11,395)

Frederick Moore Binder, Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. Arthur C. Bining

This study deals with the utilization of the several kinds of coal found in Pennsylvania. In the period before the Civil War Pennsylvania coal became a great staple of the commonwealth, and of the nation, as experimentation and technological advancements discovered new uses for it. The development of fuel experimentation, the introduction of mechanical improvements and methods of burning coal, the marketing techniques and the subsequent expansion of markets for the anthracite and bituminous wealth of the state are discussed in some detail.

The results of this study indicate that the United States, in this period, experienced the strong, young forces of the beginnings of her industrial revolution. Much of the changing economic scene was made possible through the uses of Pennsylvania mineral fuel. Many river improvements and canal and railroad transportation routes were undertaken specifically to bring Pennsylvania coal to the consumer. Stationary steam-powered machinery burned increasing amounts of coal. Blast furnace, forge and rolling mill began the shift from the more expensive charcoal to cheap mineral fuel. In the realm of transportation, the steamboat, steamship and locomotive gradually substituted mineral coal for forest wood. Urban growth reflected the significance of coal for domestic use. Home heating and cooking as well as gas light in the towns and cities of the Northeast and the Ohio Valley depended upon the carbon energy of Pennsylvania.

By 1840 the United States, by virtue of a revolution in fuel energy, had entered what the journals of the day called the "Coal Age." The concentration of anthracite coal deposits in eastern Pennsylvania made the resource a state monopoly. Before 1860 Pennsylvania furnished over 99 per cent of the hard coal of the United States. Less than four hundred tons of anthracite were mined and shipped to market in 1820. Forty years later the amount had risen to an annual production of over eight million tons. At the same time western Pennsylvania furnished almost three million tons of bituminous coal, or nearly half the total amount of the bituminous production of the United States.

In conclusion it may be stated that the roots of the industrial revolution in the United States are found in the period before the Civil War. The symptoms of a changing economic order are evident: the beginning of the concentration of population in cities; the increased use of steam-powered machinery; the investment of capital in industry and transportation routes; the large number of patents for technical improvements; the evolution of a skilled group of mechanics, and the material comfort of town and city dweller reflected in the domestic conveniences of central heating and gas light. Much of this would have been difficult, if not impossible to attain, without a source of cheap energy. Coal furnished that energy, and in turn it was Pennsylvania which furnished 80 per cent of the nation's coal.

276 pages. $3.45. MicA 55-1081

THE AMERICAN CIVIL WAR IN THE WESTERN TERRITORIES OF NEW MEXICO, ARIZONA, COLORADO AND UTAH

(Publication No. 11,882)

Ray Charles Colton, Ph.D.
University of Maryland, 1954

Supervisors: Professors Wesley M. Gewehr and Horace S. Merrill

The story of the Civil War in the Territories of New Mexico, Arizona, Colorado and Utah during the years of 1861 to 1865 is an important chapter in the history of Western America. It involved the struggle between Union and Confederate forces for control of the southwest and a conflict between the Indians and the whites. It was a venture in territorial development and the welding of pioneers with diversified ideals into the sturdy citizenry of the Intermountain West.

The Confederate leaders planned through conquest, diplomacy and Secessionist support in these territories to annex a western domain from Texas to the California coast. This would have given them a pathway to the Pacific, an area rich in minerals, new territory for the extension of slavery and valuable military stores and equipment. Officers of Southern sympathy, leading Texas Volunteers, were commissioned to accomplish this feat. High ranking Union Army officials showed little interest in the Rebel threats in the southwest until aroused by the Federal defeats at Fort Fillmore and Valverde. Once awakened, the North through the aggression of the Colorado Volunteers, with some Army Regulars and New Mexican Militia, turned the Rebels back at Glorieta

and started them on a disastrous retreat back to Texas. The advance of the California Volunteers to the Rio Grande assured the Union success. The Confederate dream of a new territory and outlet to the Pacific was shattered.

Indian leaders in the Rocky Mountain Territories, recognizing in the Civil War between the white men an opportunity to reconquer what they had lost, viciously attacked along the roads, trails and outlying settlements. Confederate and Union leaders struck back with Indian extermination orders. In New Mexico and Arizona the Navahos, and part of the Apaches, were forced to go to the Bosque Redondo Indian Reservation. The plundering Plains Indians kept Colorado in an emergency status during most of the Civil War. Concentrated troop movements lessened the threat of the Redmen. Colorado volunteers massacred a friendly band of Indians at Sand Creek, causing a furious flareup of the Plains Indians and a Congressional investigation. In present day Wyoming the Indians attacked along the Overland Mail Route. The Utah militia responded, protecting the mail and telegraph lines until relieved by other Federal troops. California volunteers defeated Shoshones and Bannocks at Bear River. This broke the power of the Indians along the Utah-Idaho border. The Utah Indians were repulsed and several treaties in the Mountain Territories were made toward the close of the War.

The Western Territories made significant political advances during the Civil War. In Colorado, which remained loyal, a new territorial government was launched and a basic political foundation was established. Utah's political history during the war was unique. No Confederates invaded the territory. The interests of the citizens were alien to the Southern Cause. The Mormons stood by the Union, yet California troops occupied the territory ostensibly to protect the Overland Mail Route and telegraph lines but actually were sent to maintain a military surveillance over the territory. The majority of the New Mexicans remained loyal cooperating with the Union commanders in repelling the Rebel invasion. There were two Arizonas during the Civil War. The Confederates created a territory from the southern part of New Mexico, but the movement collapsed with the retreat of the Rebel troops back into Texas. During the later war years the Federal Territory of Arizona was inaugurated and administrative and judicial processes were set up.

The termination of the war brought to a close a vital narrative in the history of Western America depicting the Confederate invasion and expulsion, the struggle between the whites and the Indians and the political development of the Western Territories.

323 pages. $4.04. MicA 55-1082

BRITISH AND AMERICAN ATTEMPTS TO COORDINATE THE DEFENSES OF THE CONTINENTAL COLONIES TO MEET FRENCH AND NORTHERN INDIAN ATTACKS, 1643-1754

(Publication No. 11,288)

John Christensen Hammelef, Ph.D.
University of Michigan, 1955

Successful defense of the British colonies on the North American continent required military cooperation between provinces. Leaders in the New World and at home soon learned this, but since frontier settlements were widely scattered and the colonies politically separate, joint activities were difficult to arrange.

Between 1643 and 1748 united action was tried repeatedly. The New England Confederacy was quite successful; other methods of permanent, formally organized cooperation either failed or were never tried. Among these were William Penn's confederation plan, the Dominion of New England, and the Board of Trade's joint-governorship system. On the other hand, periodic Indian conferences and councils of war developed habits of voluntary intercolonial cooperation. Outstanding among these meetings were the Albany Congresses and the Leisler conference of 1690. During the first half of the eighteenth century, little was done to improve colonial defensive cooperation. Military forces and supplies for joint campaigns were raised by requisitions on the colonies, but the provinces refused to agree upon the proportion each should furnish and usually failed to fill assigned quotas.

Following King George's War, the French attempted to seize control over the lands west of the Appalachian Mountains. British leaders and the continental American colonists soon became alarmed and sought to strengthen colonial defenses. Most of their proposals merely involved the expansion of current defensive activities, but Benjamin Franklin and a few friends developed a comprehensive plan for intercolonial confederation. In 1751 Archibald Kennedy proposed annual conferences between the provinces on Indian and military affairs, and Franklin suggested that a permanent intercolonial council handle these matters and share responsibility with a royal governor general. At the Albany Congress of 1754, Franklin presented a more complete scheme for confederation, and the committee on unification recommended a modified version of these "Short Hints" to the general conference. A partial copy of the committee report survives in the handwriting of Mesheck Weare of New Hampshire. After considerable debate and the addition of many details, Franklin rewrote the scheme as amended by the congress, and the commissioners recommended the resulting Albany Plan to the provinces for adoption.

Most of the colonial assemblies voted against the Albany Plan of Union; the rest ignored it. Only the Connecticut and Massachusetts legislatures examined the scheme in detail. Both appointed committees which prepared substitute plans; Connecticut's now exists only as two drafts in the handwriting of

Jonathan Trumbull. Governor Shirley of Massachusetts also proposed fundamental changes. In England the Board of Trade prepared a union proposal of its own, but otherwise confederation received little attention.

Unification was postponed when hostilities with France began in 1754. The requisition system was revived with fair success, and the British finally conquered New France during the French and Indian War. Thereafter agitation for close intercolonial cooperation or unification practically ceased until the American Revolution. The Albany Plan and other early confederation schemes were then used by Joseph Galloway and Benjamin Franklin to prepare unification proposals in 1774 and 1775.

265 pages. $3.31. MicA 55-1083

GERMAN RELATIONS WITH THE HOLY SEE, MARCH 1937 TO SEPTEMBER 1939

(Publication No. 11,289)

William Millard Harrigan, Ph.D.
University of Michigan, 1955

This study traces German relations with the Holy See during a rather crucial period in their history, from the issuance of the papal encyclical on the persecution of the Church in Germany, Mit brennender Sorge, until the outbreak of World War II. It also contains an introductory chapter on the period from 1930 to 1936. It is not so much concerned with the day-to-day details of the struggle between the Roman Catholic Church and the Nazi State within Germany as with a discussion of German-Vatican relations at the level of haute politique.

In March 1937, after the repeated failure of Vatican efforts to force a return to the provisions of the Reich Concordat, Pius XI issued his encyclical on the persecution of the Church in Germany. The German Government replied with its customary countercharge of political Catholicism and with increased pressure on the Church through the resumption of the temporarily suspended "Morality Trials" of Catholic priests. Two months later German-Vatican tension was further increased by a speech of Cardinal Mundelein of Chicago which contained insulting references to the Führer. When the Vatican refused to accept the Reich's demands for an apology and tried to tie in with the Mundelein speech the whole question of German-Vatican relations, the Government suspended "normal relations" with the Holy See.

During the next two years the Nazi attacks on the Catholic Church continued despite the repeated protests of the Holy See. The Catholic associations, schools, and press were gradually eliminated. Denominational religious instruction in the community schools was seriously undermined, and Catholic seminaries, theological faculties, and religious houses were closed. Moreover, artificially staged demonstrations against Catholic prelates, such as Bishop Sproll of Rottenburg and Cardinal Innitzer of Vienna, were attended by great acts of violence. The Government met the protests of the Holy See with a policy of procrastination, postponement, and eventual denial of redress. In short, it pursued a consistently negative policy.

The Reich Government seriously considered abrogating the Concordat, but Hitler never took this drastic step because of the adverse propaganda effects which undoubtedly would have ensued. The Government constantly maintained that there was no persecution of the Church in Germany, nor even any hostility on the part of the Nazi regime toward the Christian religion. Since the persecution was carried out locally and piece-meal, it could to some extent be camouflaged. Such a camouflage was important not only in obtaining the support of the Catholic population of Germany but also in winning the loyalty of the Austrian population and the full acceptance of the Italian people of a German-Italian alliance.

A slight and superficial détente in German-Vatican relations occurred in 1939 after the death of the elderly and outspoken Pius XI, whose public outbursts against the growing neopaganism of the Nazi State infuriated the German Government. However, the efforts of the new pope, Pius XII, to reach a modus vivendi with the Government proved entirely fruitless, and his task became immeasureably complicated with the coming of World War II and the problems arising from the German occupation of non-German Catholic territories. At any rate, the basic antagonism between Roman Catholicism and the Nazi Weltanschauung made a lasting agreement impossible. The Holy See's efforts to curtail the totalitarian claims and anti-Christian character of National Socialism merely encouraged Hitler in his decision to completely exclude the Church from any influence in German life at the end of the war.

274 pages. $3.43. MicA 55-1084

THE EVOLUTION CONTROVERSY DURING THE 1920'S

(Publication No. 10,635)

LeRoy Johnson, Ph.D.
New York University, 1954

The problem was to determine the nature of the attack made by the Fundamentalists on the freedom to teach evolution in the tax-supported schools in Arkansas, Kentucky, Mississippi, North Carolina and Tennessee during the 1920's.

The problem resolved itself into the following sub-problems:

1. To determine the basic issues of the controversy.
2. To determine the positions of the opposing sides on these issues.
3. To determine the strategy of action of the opposing sides.
4. To determine the successes of the opposing sides.

Historical Perspective

The Bible portrays man's great dilemma, reveals a mighty issue at stake, whether he should rely on his own natural powers or on the supernatural powers of a Supreme Being, Yahweh, God, in meeting his needs. With the scientific method man revised his attitudes toward the world and his place in it. The theory of evolution coalesced the new attitudes into a world-view which opposed the traditional Christian world-view. Man's great dilemma, his mighty issue became urgent again.

Basic Issues in the Controversy

The evolution controversy during the 1920's resolved itself into a conflict between two world-views. At the extremes the point at issue was man's ancient dilemma, whether he should place his destiny in the hands of God or in his own hands. The basic issues in this dilemma, and the controversy, were the nature of God, man, truth and the content of education.

Positions on the Basic Issues

The Fundamentalists generally took the following positions:

> God is the three persons of the Trinity, Father, Son and Holy Spirit; man is the product of a creative act of God; truth is the Word of God; and education embodies the concepts of those who provide the schools and the pupils.

The Modernists generally took the following positions:

> God is immanent throughout the universe; man is a product of an evolution from a lower order of life; truth is the word of man; and education embodies the concepts of those who teach the schools.

Strategies of Action of the Opposing Sides

The broad objectives of each side were to create and organize group opinion to support its positions on the basic issues through democratic processes. In 1921 the Fundamentalists of the Northern Baptists failed in their major effort to eradicate Modernism from Baptist schools. Following this failure widespread attempts were made by members of several denominations to prohibit the teaching of evolution in tax-supported schools.

Successes of the Opposing Sides

Anti-evolution bills were introduced in the legislatures of twenty states and became the law in Arkansas, Mississippi and Tennessee. The laws were widely evaded. In many places local opinion banned the theory.

Sources of Data

The data were obtained from the laws in statute books, actions of religious and learned organizations in their official reports, and the sermons, speeches and articles by the protagonists in books, periodicals and newspapers.

Conclusions

The controversy did not resolve the conflict between the traditional Christian and the evolutionary world-views. Moreover, the crisis was not altogether unique. It was one more episode in the conflict between the old and the new which has confronted the church since its beginnings.

218 pages. $2.73. Mic 55-102

GENEVA AND THE COMING OF THE WARS OF RELIGION IN FRANCE, 1555-1563

(Publication No. 11,460)

Robert McCune Kingdon, Ph.D.
Columbia University, 1955

This dissertation attempts to make more precise our knowledge of the role of the Geneva Company of Pastors, with John Calvin as its Moderator, in directing the activities of missionaries sent from Geneva to France in the years just preceding the outbreak of the French religious wars, 1555-1563. It consists of an analysis of the background, training, examination, placement, and continuing discipline of eighty-eight of these missionaries, plus a narrative of those political activities of the ecclesiastical organization thus formed for which the Geneva Company bears some responsibility.

The eighty-eight missionaries had come to Geneva from nearly every province in France. Many of the leaders among them were of noble birth; the majority of them were probably of middle-class origin. At the University of Geneva or at the Lausanne Academy most of them had been trained in Biblical languages, in knowledge and exegesis of Biblical texts, and in Calvinist theology. They had been examined as to their competence, orthodoxy, and ability to express the basic Calvinist doctrines. Finally they had been accredited, secretly led into France, and placed in pulpits that had been selected for them, on the basis of requests sent to Geneva from local congregations. Even in the pulpit they were not permitted entire independence of thought and action. Local consistories, regional colloquies, provincial and national synods were quickly formed, and they, with the pastors of Geneva, watched over the missionaries to make sure that they maintained their skill and orthodoxy and that they co-operated with the general ecclesiastical organization.

The policies that the Geneva Company of Pastors instructed the Reformed ministers in France to follow varied over the years. At first these men were told to keep all Protestant activity secret and to seek support from certain powerful noblemen. Some of them were tempted to exceed the general advice from Geneva by joining in conspiracies for the sake of establishing Protestantism in France, a lure to which even a few of the Geneva leaders responded. When royal oppression was relaxed somewhat in 1561, the pastors immediately began, with Geneva's full approval, the most active campaign of public Protestant evangelization France has ever seen, centering

their activities in certain big cities and in provinces controlled by members of the high nobility who were sympathetic to Protestantism. A flood of books from Geneva helped the pastors in this phase of their evangelical campaign. Finally, when Catholic repression threatened to destroy their work, the pastors joined ranks with the Huguenot noblemen led by Condé and persuaded their congregations to devote men, money, and munitions to religious war. The city of Geneva set an example for these militant missionaries by negotiating loans, assisting the passage of mercenaries bound to France, and contributing armament to the forces battling for Protestantism, under the cloak of official neutrality.

The Geneva Company of Pastors was clearly able to maintain rather firm control over the thought and the ecclesiastical organization of French Protestants. This, in itself, caused political trouble, though the Geneva pastors tried, with considerable success, to adapt their policies to the practical demands of the political situation in France. They were least successful in controlling the political and military activities of Calvinist noblemen, and many of the setbacks to their policy were due to the activities of Huguenot leaders acting against ministerial advice.

This study thus supplies new information gained largely by research in Swiss archives on the problems of the politics of early French Calvinists posed by Nürnberger, on the nature of their pastorate as analyzed by Heyer, and on the history of their activities as narrated by Imbart de la Tour, Romier, and others. 354 pages. $4.43. Mic 55-103

A CRITICAL HISTORY OF THE COLLEGE OF AGRICULTURE, STATE COLLEGE OF WASHINGTON, 1892-1916

(Publication No. 11,848)

Patrick M. Murdock, Ph.D.
State College of Washington, 1955

This study deals with the development of agricultural education and experimentation at Pullman, Washington, from the enabling act for Washington statehood (1889), which reflected the spirit of the land grant program, to the accession of President E. O. Holland, who took over a mature and well-developed college in 1916. The personalities, politics, and problems involved in the chartering, location, and operation of the college are presented.

Starting with the one-building establishment opened on January 13, 1892, and the first farmers' institute held at the end of that first month of its existence, the story is related within the framework of a general college history. The emphasis remains on the personnel, problems, and projects of the department of agriculture and closely allied departments within the Washington Agricultural College, Experiment Station, and School of Science, which after 1905 became the State College of Washington, and on the work of the experiment station, branch stations, and the institution's extension workers.

The hectic and emotional situation created by diversity of opinions of what the college should be and, especially, of where it should be located was such as to give the college two presidents, George Lilley and John Heston, within nineteen months of its establishment. This was accompanied by a change in the personnel of the Board of Regents, an ambitious building program, and by the survey of sites for branch experiment stations. The precedent for a strong administration, to endure for the period covered in this study, was established within the first year and a half of the existence of the college.

In accordance with the board's predilection for strong administrative leadership, it employed on July 22, 1893, Enoch A. Bryan as president and director of the experiment station. He held both positions until 1907 at which time he relinquished the directorship and remained president until 1916. Associated with him were a succession of agricultural workers including E. R. Lake, C. V. Piper, E. E. Elliott, W. J. Spillman, George Severance, W. S. Thornber, and R. W. Thatcher, who were to contribute to Washington agricultural development. Several of these men were to move to other colleges and into larger fields of effort within the United States Department of Agriculture. Of these Spillman, a virtual independent rediscoverer of the Mendelian theory, achieved most renown.

Numerous studies were undertaken by the experiment station at Pullman and its several sub-stations in wheat genetics and culture, fruit growing, grasses, dairying, sugar beet production, flax culture, animal breeding, veterinary medicine, and insect and fungus control. Also, there was steady experimentation with the means of disseminating agricultural information through farmers' institutes, special short courses for working farmers, secondary curricula for farm youths, demonstration farms and trains, and county agent work. Paralleling these activities was a continuing shift in the agricultural curriculum and in departmental organization.

A diminution in agricultural enrollment occurred at the time of the Spanish-American war. In the decade prior to World War I, it recovered, however, and then exceeded the count of the engineering and liberal arts students during the 1890's. With such increases came the problems of plant and faculty expansion which in turn were met by increases in both state and federal financial grants to develop the college into a complex organization, requiring administrative reorganization until the time this study concludes.

Generalizations are reached concerning the uniqueness of the Washington experience and the impossibility of foreseeing the development in Washington agricultural education during the period studied. The vulnerability of the laboratory method employed to deal with agricultural problems is revealed. This dissertation concludes with a discussion of the possibilities for further historical research into the history of the State College of Washington.

Accompanying the dissertation is a bibliographical note especially concerned with the local, and particularly archival, resources used and their availability for both the agricultural and general history of the State College of Washington.

262 pages. $3.28. MicA 55-1085

THE PROPOSED BRITISH CARIBBEAN FEDERATION

(Publication No. 11,877)

Gerald Grogan Smith, D.S.S.
Syracuse University, 1955

This dissertation analyzes the requests for federated self-rule by investigations into the historical, geographical and sociological past of the British Caribbean. It also evaluates proposals by Canadian and West Indian statesmen. Another interest is to investigate the nature of the Commonwealth into which the British Caribbean Federation may some day assume a co-equal position.

With few exceptions the junior commonwealth or dependent empire of Great Britain in the western hemisphere was established in the seventeenth and early eighteenth centuries, the Napoleonic Wars marking the end of British conquest and settlement. By the end of the eighteenth century the colonies were highly prosperous, but their prosperity was precarious, depending upon sugar, the plantation system, Negro slaves, and mercantilism. The islands ceased to dominate the hemisphere's trade after the emancipation of the slaves, the swift development of technology, and particularly the production of beet sugar. With the opening of the Panama Canal, the importance of the islands focused imperial and world attention on the area once again.

Federation of the British Caribbean Islands began during the reign of Queen Anne when in 1705 the Leeward Islands were federated under a legislature that met until 1798, and include such highlights as the federation of the Leeward Islands by Act of Parliament in 1871, and the union of the Windward Islands under a single governor in 1885. Additionally, the influence of other factors pointing toward federation were the numerous Royal Commissions of Inquiry, the most important being that headed by Lord Moyne in 1938-39, the Colonial Development and Welfare Acts of 1929, 1940, 1945, and others, and the work of the four-nation Caribbean Commission which began in 1942 as the Anglo-American Caribbean Commission and has continued to the present. After the Second World War the Crown Colonies met together at Montego Bay, Jamaica, in 1947, and decided upon the principle of closer union by setting up the British Caribbean Standing Closer Association Committee headed by Lord Rance. The Standing Closer Committee drew up a framework for federation which was accepted by the legislatures involved, except British Guiana, British Honduras, British Virgin Islands. At the London Conference on West Indian Federation, April, 1953, the Rance Committee recommendations were unanimously accepted by the Crown Colony representatives concerned, and the United Kingdom government. Legislative ratification began in late 1953, and by December, 1954, all of the Unit Governments concerned except Trinidad had ratified.

At the present time the Crown Colonies of Barbados, Jamaica, Antigua, St. Christopher-Nevis, Montserrat, Trinidad, Grenada, St. Vincent, St. Lucia, and Dominica, and the government of the United Kingdom are in negotiations which may lead finally to the federation of the British Caribbean dependent empire. The British Caribbean is but one of the regional areas being considered for federated self-rule in the world-wide realm of Elizabeth II, but it is the area of greatest importance to the United States because of its proximity to the Panama Canal and its economic potential, in war and peace, as a storehouse of tropical products and as a market. Besides their importance strategically as military outposts, the British Caribbean islands have made significant advances democratically and are interesting areas for the study of race and social problems.

The London Conference of 1953 has recommended federation in internal matters as a step toward complete dominion status. The success of this venture depends largely upon the islands' continued progress in social, political, and especially economic matters equal to that progress made during the last two decades. 259 pages. $3.24. MicA 55-1086

EDOUARD DROUYN DE LHUYS AND THE FOREIGN POLICY OF THE SECOND EMPIRE

(Publication No. 11,435)

Warren F. Spencer, Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. Lyman M. Case

Drouyn de Lhuys was foreign minister of the Second Empire twice: 1852 to 1855 and 1862 to 1866. These periods covered the important diplomatic events of the recognition of the Second Empire, the Crimean War, and the early years of the movement toward German unification. Yet there are many histories of the foreign policy of Napoleon III that no more than mention Drouyn and there are none that undertake a serious examination of the man and his theories. Although he was a close associate of the emperor in these important diplomatic events, his role in them has never been analyzed. This study is an attempt to place him properly as an executor of foreign policies and to arrive at a fair judgement of his place in history.

Certain selected archival materials apply to this study; there are many collections of documents published by various governments that are pertinent to the subject; and the many memoirs and diaries of Drouyn's contemporaries are most informative. A comparison and analysis of these sources revealed

much of the man and his theories and made it possible to develop a valid story of his role in the making of French foreign policy.

The Crimean war diplomacy of the Second Empire was practically the personal work of Drouyn. He was responsible for the one act considered the immediate cause of war between Russia and the Western powers. The Vienna Note, the four points, and the Tripartite Treaty of December 2, 1854 were the result of his work. The statement of the rights of neutrals, which appeared in the Treaty of Paris of 1856, and the neutralization of the Black Sea were his ideas.

During the controversies involved in the movement for German unification, Drouyn applied the traditional French policy of keeping Germany divided. But he differed with Napoleon as to which of the German powers, Austria or Prussia, needed French help in order to maintain a balance between them. This difference was largely responsible for the ineffectiveness of French policy which greatly aided Bismarck in the accomplishment of his program. After the battle of Sadowa, Drouyn advocated an armed mediation which, had it been followed, would have greatly altered the course of German and European history.

From this study it is concluded that Drouyn, not Napoleon, precipitated the Crimean War. In his second ministry, French policy during the Schleswig-Holstein question and the Austro-Prussian war reacted against French interests. At the same time, Drouyn's positive policy was a sound and good one for France. The difficulty arose as a result of the differences between him and Napoleon. This study also reveals the full impact of the growing public opinion on the ability of an accomplished diplomat to execute his policies. French public opinion, as much as any other factor, can be blamed for the rejection of his policy of 1866 – a policy which might have influenced German unification so that it would have been less detrimental to French interests.

This examination of the role of Drouyn de Lhuys in French foreign policy casts much light on the apparent ambiguities of Napoleon III's handling of foreign affairs and gives an insight into the decline and collapse of the Second Empire.

422 pages. $5.28. MicA 55-1087

JAMES OTIS

(Publication No. 11,231)

Alice Vering, Ph.D.
The University of Nebraska, 1954

Adviser: John R. Alden

James Otis was one of the foremost leaders of American resistance to British measures in the pre-Revolutionary period. One of the earliest struggles with Britain involved the validity of writs of assistance. Otis' argument against the writs is famous in American legal history. The odium of these writs led to provisions forbidding their use in the federal and in many state constitutions. Otis' plea that "an act against the Constitution is void" became part of the American system of government, in large part through the decisions of the United States Supreme Court under Chief Justice John Marshall.

Otis was regarded more highly as a writer and political theorist in his own day than he is today. Most of his writings dealt with contemporary political affairs. His reputation as a political theorist rests in large part on the pamphlet The Rights of the British Colonies. In this pamphlet and in other writings he adapted the ideas of natural law philosophers to the colonists' cause.

Until 1765 and perhaps much later, Otis was the real leader and director of the activities of the Boston town meetings. As a member of the Massachusetts House of Representatives he dominated its proceedings.

Otis suffered from a disease, probably manic depressive insanity, which affected his political career. He was accused of "Toryism," of being "bought off." More likely the periods of "radicalism" and "reaction" in his political life corresponded to the cycles of the disease. He was vigorous in asserting colonial rights and in proposing measures of opposition to British policy in the manic cycle, cautious to prevent "rash" action by his compatriots in periods of depression.

Whatever his failures or inconsistencies, his radicalism or lack of it, the testimony of both friends and enemies accords to him the leading position in Massachusetts politics from 1760 to 1769. There are some reasons to believe that he more than any other single person determined the character of American opposition to British measures in those years. Massachusetts and Virginia were the great strongholds of those who demanded for the colonists "the rights of mankind." That Massachusetts was in the forefront of the struggle with the British government must be explained in part at least by the personality and activities of Otis.

The earliest opposition to writs of assistance and British customs practices was directed by Otis. In 1764 he led the first movement for intercolonial cooperation in opposition to Parliamentary measures. He urged the Assemblies to instruct their agents in London to agree on a united petition against the Sugar Act. The plan for an intercolonial congress was originated by Otis and resulted in the Massachusetts call for the Stamp Act Congress. Hutchinson assigns to Otis a major part in promoting the non-importation agreements which were pushed more vigorously by Massachusetts than by any other colony. Otis was also closely connected with all early plans for committees of correspondence. When the committees were formed, Otis became the first chairman of the Massachusetts committee. Otis was the leading figure in promoting the Massachusetts Circular Letter which consolidated colonial opposition to the Townshend duties. In summing up Otis' activities one is led to believe that John Adams correctly placed Otis "first and foremost" among those "characters the most conspicuous the most ardent and influential" in the early sixties. 320 pages. $4.00. Mic 55-104

CHURCH AND STATE IN NEBRASKA 1854-1950: A STUDY OF THE LEGAL RELATIONSHIP

(Publication No. 11,234)

Orville Herman Zabel, Ph.D.
The University of Nebraska, 1954

Adviser: John R. Alden

The specific purpose of this study was to determine what has been the legal relationship of church and state in Nebraska from 1854 to 1950. Legal materials provided the major sources of information.

Separation of church and state in Nebraska has meant that no particular religious society has been given special privileges or status by the state and that the state has not exercised undue control over the church. At the same time, separation of church and state has not meant that the state has no concern for religion. In Nebraska not only is the state committed by its fundamental law to protect religious freedom, but in official pronouncements agencies of the state have consistently shown deep respect and consideration for religion and God. Moreover, the state officially participates in various religious ceremonies and has granted a number of privileges, especially tax exemption, to religious societies and their representatives.

Problems of adjustment between church and state in Nebraska have been more frequent than is generally realized. The field of education has been a particularly controversial area. Some problems have resulted from attempts to include various kinds of religious training in the public schools. Other problems have involved the parochial schools, which, although confirmed in their right to exist by the United States Supreme Court, have been increasingly regulated by state legislation.

Nebraska practices are apparently not too different from those of other states in the area of church-state relationships. Moreover, it would seem valid to say that the agencies of the State of Nebraska have usually been found on the side of religious liberty although, at times, various types of pressure have resulted in actions opposed to religious liberty.

Nebraska has effectively used local option to enlarge the religious freedom of its citizens. It may be that statutes such as those prohibiting Sunday barbering and the wearing of religious garb by teachers should be examined with reference to the possibility of placing those activities under local option. Statutes such as those prohibiting profanity and setting controls over Sunday activities are far more often violated than enforced, and the possibility of their repeal might receive serious consideration.

Some problems of adjustment in the area of church-state relationships in Nebraska, although not of immediate concern, may well demand solutions in coming years. At present there is apparently little controversy in Nebraska concerning the desirability of granting tax exempt status to property used for religious purposes. It is not unlikely, however, that this matter will be re-examined. Certain problems related to the field of education, which as yet have not been of major concern to Nebraskans, have aroused considerable controversy elsewhere and might well break out into heated controversy in Nebraska at any time.

While the State of Nebraska has placed quite satisfactory limitations upon its control over religious societies, the gradual expansion of federal jurisdiction over church-state problems may result in a changed church-state relationship.

At times bitter controversies have arisen in Nebraska over the proper relationship of church and state. Out of these controversies there has been achieved a reasonable working relationship between the various religious societies and the state. It may be expected that in the future other controversies will arise over the proper relationship of church and state. It may also be expected that a reasonable working relationship will be maintained if Nebraskans are willing to protect the religious freedom of all in the best American tradition by permitting all views to be expressed and discussed openly.

302 pages. $3.78. Mic 55-105

JOURNALISM

AN EVALUATION AND AN INTERPRETATION OF THE STATISTICS RELATING TO THE MASS COMMUNICATIONS INDUSTRIES

(Publication No. 11,494)

Richard Earl Chapin, Ph.D.
University of Illinois, 1955

This paper is a compilation, evaluation, and interpretation of all of the available statistics regarding the mass media of communication – namely, newspapers, books, magazines, radio, television, and motion pictures. As such it gives some substance to the "who" and "to whom" of the classic statement which summarizes communication research: Who says what to whom with what effect?

A chapter is devoted to each medium which is considered in light of ten basic questions: How many consumers are there for the medium? How much use do they make of the medium? How much does it cost the consumer to receive a communication through the medium? The remaining seven questions

concern the producers of mass communications – How many? What are their revenues? How many people are employed and what are their wages? What are the expenses of producing a communication? What is the total income for the industry? What rate of return is there on the investment? How much competition is there within the medium and between all of the media? An answer is sought for each of these questions in available statistical sources. When the series were not available in published sources, the author compiled a new statistical series when possible. Each of these series was evaluated in terms of reliability, validity, and comparability. In addition to the evaluation each series was analyzed in light of its historical continuity, trends were noted, and the series were interpreted in an effort to answer the above stated questions.

In Chapter II, entitled "A Perspective on Communication," the author has attempted to summarize all of the series principally by use of semi-logarithmic graphs. In this respect cross media comparisons are made, particularly for the consumers. With data analyzed in this light for the first time it was found that the average expenditure per household for the mass media in 1952 was 121 dollars. A breakdown of this figure shows that $26 was spent for television sets; $14 for radio sets; $10 was expended for the repair of radio and television sets; motion picture tickets consumed $25 of the total; newspapers cost $19; magazines $13; and the average household expenditure for books was $14.

The final chapter of the paper deals with an analysis of the statistical sources for the mass media of communication. Here an attempt is made to show the weaknesses and the gaps in the available sources. In addition to pin-pointing these, the author has suggested possible solutions to the overall problem of strengthening the statistical sources in this area.

316 pages. $3.95. MicA 55-1088

MEASURING ADVERTISING EFFECTIVENESS FROM A COMMUNICATIONS POINT OF VIEW

(Publication No. 11,521)

William Anthony Mindak, Ph.D.
University of Illinois, 1955

To provide a frame of reference, the author has discussed advertising as a communications process, noted difficulties in measuring "effectiveness" of an advertisement, and classified the most popular advertisement tests by function.

It was then suggested that an advertisement test which measured only reader attention or interest, or reader recall or comprehension – all measures of advertisement penetration – without indicating what effect the advertisement had on consumer attitude or his disposition to buy would fall short of providing an accurate index of an advertisement's effectiveness.

The semantic differential is then introduced as a technique eminently suited to the measurement of attitude change. This technique, developed by Charles Osgood at the University of Illinois, had been applied in related fields of communication.

The use of the evaluative factor of the semantic differential as an attitude scale provides these potential advantages:

1. It decreases to a certain extent the amount of control a respondent has over his reactions to advertisements. For many products and many advertisements this would be particularly desirable.

2. It offers possibilities of developing generalized attitude scales which might be used for many different products, slogans, sponsors, headlines.

3. It may permit getting two or more measurements of the same group of respondents. Thus it would indicate not only what attitude change a particular advertisement might have brought about, but what attitude the consumer introduced into the exposure situation.

Three studies using the semantic differential's evaluative factor as an attitude scale were then reported.

The first study dealt with attempts at pre-evaluating potential effectiveness of five different radio commercials for a new hand lotion. Its results indicated that:

1. When comparing rankings of commercials according to attitude scales, consumer jury and recall tests, it was shown that there was almost a negative correlation between commercials doing well on changing consumers' attitude and those with highest recall levels. When comparing consumer jury tests with attitude scales, the rankings were more similar although the commercial best liked by the group did not really change the group's attitude toward Soft Touch, while the commercial which actually did change attitude was listed second-best.

2. A comparison of observed changes in attitude with predicted changes in attitude – based on the Osgood-Tannenbaum "Congruity Principle" which applies whenever a favorable assertion links a source and concept or any two concepts – disclosed a definite if slight relationship between observed and predicted changes for five out of six comparisons.

The second study obtained measurements of recognition, meaning, and believability of slogans for leading beers in a particular metropolitan area. Again, the attitude scale used was the semantic differential. Results indicated that a slogan might be well recognized and associated with its product, yet have correspondingly fewer people believing, and still fewer people understanding it.

The third study using the semantic differential concerned itself with consumers' attitudes toward a number of products and their slogans. As might have been expected, there was a tendency for individuals who could associate the product with the slogan to rate both more highly than individuals who could not associate both the slogan and the product. However, there was one significant exception in the case of Lord Calvert whiskey and its slogan, "For Men of Distinction." Subjects who associated Lord Calvert with its slogan tended to react more unfavorably on all scales toward both the product

and the slogan than those who did not know the association.

In conclusion, it is suggested that the semantic differential used as an attitude scale is indeed a reliable and useful instrument for measuring and pre-evaluating advertisement effectiveness. It is further suggested that advertisement testers adopt even more of the techniques being used in other related fields of persuasive communications today.

118 pages. $1.48. MicA 55-1089

CONSUMER MAGAZINES IN THE UNITED STATES, 1900-1950: A SOCIAL AND ECONOMIC HISTORY

(Publication No. 11,525)

Theodore Bernard Peterson, Jr., Ph.D.
University of Illinois, 1955

The low-priced popular magazine of national circulation emerged in the late nineteenth century as America made the transition from an agrarian to an industrial economy. It emerged as changes in the distribution of consumer goods brought about a growing volume of national advertising. By joining the magazine with the system of marketing, national advertising affected many aspects of the magazine industry. As the volume of advertising increased, magazines grew in numbers and in circulation.

Also important to the development of the magazine was an expanding market both for magazines and for the goods advertised in their pages. The magazine audience was widened by a rise in population and by such fruits of democracy and industrialization as an increase in leisure time, an increase in the general level of education, and a shift in the distribution of income. Magazines of mammoth circulation became commonplace after World War I as a result of the expanding market, technological advances, and improvements in the logistics of magazine publishing.

Although the bulk of national advertising gravitated to magazines of large circulation, the leading magazines were by no means invulnerable to competition. The magazine industry remained hospitable to the inventive newcomer, who often could experiment with less financial risk than the established leaders. As new publishers introduced new magazines attuned to the changes in the pattern of American life, many of the magazines which had once led in circulation and prestige were driven out of business. Others, adapted to changing circumstances, managed to survive. The magazines which died were replaced by new leaders which achieved huge circulations in relatively short periods, especially after World War I. Since some of these new leaders were based on fresh ideas, since other publishers imitated the successful innovations, whole new classes of magazines emerged during the twenties, thirties, and forties, among them the news magazines, the digests, the modern picture magazines, and the confession magazines.

495 pages. $6.19. Mic 55-106

LANGUAGE AND LITERATURE

LANGUAGE AND LITERATURE, GENERAL

AN INTRODUCTION TO THE PROBLEM OF ALLEGORY IN LITERARY CRITICISM

(Publication No. 11,244)

Abraham Bezanker, Ph.D.
University of Michigan, 1955

The problem in literary criticism which allegory presents is, essentially, the search for a right esthetic response to what is commonly regarded as an alien mode of expression. The difficulties of this search are increased by the inadequate efforts of critics to define the term "allegory," and they are multiplied by other critical approaches to the allegorical form. Benedetto Croce's willingness to ignore allegory for the sake of the poetry, C. S. Lewis's attempts to deal directly with individual allegorical works, and H. F. Dunbar's effort to equate "true" allegory with the kind found in The Divine Comedy, are all beset with various intellectual and critical weaknesses. An alternative approach which appears to offer some advantage over all of these is the Geistesgeschichte method utilized by Ernst Cassirer in Das mythische Denken. A preliminary account of Cassirer's analysis of mythic expression in terms of epistemological implications suggests that it is applicable to the problem of allegory.

Examination of St. Augustine's defense of allegory as an instrument of Biblical exegesis indicates the applicability of Cassirer's method to medieval allegory. Augustine's is one of the earliest attempts to formulate that relation between language and reality which is involved in any explanation of allegory, and his epistemology greatly influenced the medieval efforts to justify exegetical allegory. Other attempts, also occasioned by the unique position of the Bible in Christian culture, were the linguistic Dualism of Hrabanus Maurus, the Nominalism of Berengar of Tours, the Conceptualism of Peter Abelard, and the Transcendentalism of Hugo of St. Victor. Each of these epistemologies was affected by the necessity to justify Christian dogma, and each influenced the

theory of exegetical and literary allegory in the Middle Ages. Some of their philosophical consequences are examined through St. Thomas Aquinas' synthesis of many of these diverse views.

A preliminary attempt is then made to correlate some of these philosophical movements with esthetic qualities to be found in four medieval allegories: The Castle of Love, Anti-Claudianus, The Battle of the Seven Arts, and The Quest of the Holy Grail. A brief analysis of these works suggests that each reflects certain aspects of the philosophies already discussed, so that some of the theological attitudes toward allegory seem to have their counterpart in allegorical expression during the Middle Ages.

The same method is applied to some Renaissance views of Biblical allegory, utilizing works of Luther, Erasmus, and Colet. It appears from this evidence that the later theologians exhibit a willingness to reject arbitrary or hierarchical interpretations of Biblical allegory and to insist, instead, upon common sense and individual experience as exegetical criteria. An associative freedom to allegorize is thereby suggested which is strikingly different from some medieval views and which also lacks the philosophical profundity of the earlier period. This survey of Renaissance theologians indicates that an attempt to establish a correlation for the later period between literary allegory and Biblical allegory would perhaps reveal much less variety in the form, along with a changed standard of valid interpretation which might have had some effect upon the nature of allegorical creations.

It therefore seems reasonable to conclude that, despite the hazards of Cassirer's method, the possibility of using it to derive relationships between epistemologies and kinds of allegories may provide a solution to one of the special problems of literary criticism. 231 pages. $2.89. MicA 55-1090

AMERICAN SLAVERY AND RUSSIAN SERFDOM; A STUDY IN FICTIONAL PARALLELS

(Publication No. 11,453)

Hannah Stern Goldman, Ph.D.
Columbia University, 1955

This study applies the method of comparative literary analysis to a group of pre-emancipation Russian and American novels and sketches distinguished for their sympathetic concern with the theme of human bondage. The purpose is to trace the significant parallels in the treatment of this theme to be found in the fiction of both countries, and to show how such parallels took their course from the powerful pressure of the kindred institutions of American slavery and Russian serfdom.

The dissertation is divided into three sections. Part One, The Shaping of a Cause, is a brief comparative discussion of the social forces which gave impulse to this fiction in both countries. Similar elements in the national life of Russia and the United States – especially those bound up with the existence of a chattel class – provided the common ground for the development of these tales of protest. No less clearly, the stories reflected also dissimilar elements in the two cultures – differences in character of government and of the institutions of slavery and serfdom.

Part Two, The Terms of the Appeal, is an analysis of parallels in the pattern of this fictional protest. Both Russian and American novelists concerned with the corrosive effect of the institution of human bondage found their most powerful and dramatic appeal in the theme of human degradation. A society based upon bond service was depicted as corrupting all who shared in its life.

Especially the lives of serfs and slaves became in these novels anatomies of human misery. Their status as human beings destroyed by physical and moral abuse, these people were left an inferior and brutalized class. The gifted suffered the more keenly, and only rarely reaped the reward of recognition or freedom.

Even more profound, perhaps, was the debasement of the master classes. Owners of slaves or serfs, under the vitiating influence of uncontrolled leisure and power, were shown as dominated by greed, brutality, callousness, apathy and cynicism. Those whose complacency was broken by awareness of social problems and contradictions might take refuge in attitudes of helplessness or disenchantment.

These institutions left their degrading stamp upon all – clerks, government officials, legislators, business men, lawyers, doctors, teachers or divines – whose words or acts, however indirectly, supported their existence. Writers called attention to the plight of some social groups, dealers and overseers for example, who were singled out as social scapegoats. Some groups, like the poor whites in America and the unpropertied hangers-on in Russia, were doomed to live as a kind of workless waste despised by masters and servants alike.

Part Three describes the Signs of Hope as revealed in the novels of both nations. Chief source of hope was the truly heroic nature of many serfs and slaves. Equally cheering were instances of warm and genuine humanity on the part of the masters. In both countries, but especially in America, the writers – mingling plea with prophecy – discerned a growing public recognition of the need for measures of enlightened reform and change.

The work of the Russian novelists was considerably hampered by constant and rigorous official censorship. Yet such eminent writers as Pushkin, Gogol, Turgenev, Goncharov, Tolstoy and Saltykov-Shchedrin succeeded in leaving a strong and memorable expression of their criticism of Russian society under serfdom. American fiction, free of official censorship, was noticeably tractarian in tone. The works of such serious novelists against slavery as Hildreth and Stowe are unrestrained expressions of their indignation and pity. To this day, the passionate statement of these sentiments in Uncle Tom's Cabin commands a world audience. 302 pages. $3.78. Mic 55-107

MEDIEVAL SYMBOLISM AND THE DRAMATIC IMAGERY OF THE ENGLISH RENAISSANCE

(Publication No. 11,456)

A. Kent Hieatt, Ph.D.
Columbia University, 1954

The historical reasons for the appearance of profuse, uniquely functioning imagery in late Elizabethan and Jacobean drama can probably never be established, but we may seek among other styles a functional analogue to this imagery, with the object of discovering more about the qualities of imagination and culture with which it is associated. Brief exemplification of this figurative usage, on the basis of past investigations, suggests its most assured functions are the conveying of essential, otherwise unavailable information about dramatic action and characters, and the coincident imagination realization of this information as though it had been acted out. This kind of imagery significantly parallels certain contemporary English poetic imagery in non-dramatic genres. Such imagery can be distinguished from another kind which is concerned less with conveying poetically necessary information than with rendering a given meaning affective and imaginatively valid.

No precedent for the functioning of the English dramatic imagery under study can be established among previous or contemporary styles: Italian and French drama fails to reveal imagery similar in profusion or function; British, French, and Netherlandish late medieval styles contain comparatively little imagery; Middle Latin, Senecan, Italian, and certain German verse-styles contain much imagery which, however, is regularly affective alone.

No analogue having been found among short tropes, other forms of symbolism may be investigated, for which purpose terms must now include not only the symbolism which affects and that which both defines its concept and renders it affective, but also that kind of didactic and other symbolism which is more concerned to define or reveal a meaning than to exert a precise aesthetic effect.

Investigation of relevant material shows that literary symbolism which both defines and affects, and consists of explicit comparisons, not of implicit symbolic analogies, is to be found in certain medieval allegories, but not elsewhere except in the English Renaissance dramatic and poetic imagery in question: thus, the tendency to reduce entities to their purely symbolic values produces symbolism which is not primarily and sensitively affective (moralization of Classical myth, of nature in bestiary and lapidary literature, of story-material in some kinds of exempla; didactic allegory); and on the other hand the opposing tendency, by which an evidently aesthetic dimension is given to conceptual symbols, has three eventuations: (1) the symbol is set within a neutral stylistic form (e.g., didactic poetry in simple meter and rhyme): (2) the explicitness of the symbol is compromised by the addition of affective attributes (e.g., in The Divine Comedy, processional and pageantic symbolism; more strongly in the transfer of emphasis in narratives from the interpretation to the concrete events embodying it; in the addition in such narratives of attributes irrelevant to the overt assertion of symbolic congruence); (3) not the explicitness of the symbol, but its conceptualization (a) is compromised so that the overt assertion of likeness no longer defines but only affects (affective imagery), or, finally, (b) is supplemented so that this assertion both carries meaning and renders it affective (the narrative allegory and the English dramatic imagery referred to above).

Symbolic explicitness, definition, and affectiveness as found in this dramatic imagery thus appear in a series of French, Netherlandish, English, and Scots narrative and dramatic allegories, ending with The Faerie Queene. Allegory having the required qualities is restricted in the Middle Ages largely to the vernaculars of these works; in the Renaissance, to English.

Reason thus exists for supposing that similarly functioning English allegory and dramatic imagery are common manifestations of one enduring configuration of the English literary imagination in the Middle Ages and Renaissance, although a genetic connection between allegory and dramatic imagery is not demonstrated. 510 pages. $6.38. Mic 55-108

EXPERIMENTS IN POINT OF VIEW: ANIMAL, VEGETABLE, AND MINERAL NARRATORS IN THE EIGHTEENTH CENTURY ENGLISH NOVEL

(Publication No. 11,421)

Richard Kilburn Meeker, Ph.D.
University of Pennsylvania, 1955

Supervisor: Maurice Johnson

The epistolary technique and the Persian letter technique are by now familiar landmarks in the history of the English novel. However, non-human narration was also widely explored by eighteenth century novelists in their search for a point of view which would provide intimate, objective, and plausible views of life. This is a study of the non-human narrator in novels written or translated into English from 1700 to 1800.

Chapter I defines the non-human point of view and briefly surveys the history and previous criticism of the genre. The next four chapters contain, respectively, studies of animal, spirit, money, and other object narrators. Such a classification allows for both historical and analytical treatment. Special emphasis is given to major works in the genre, such as The Devil on Two Sticks, Pompey the Little, Chrysal, and The Sofa. Appendix I contains a checklist and location of all titles discussed. Appendix II lists other possible titles which were unobtainable.

In all, fifty-two novels written between 1700 and 1800 have been found to employ a non-human point of view. All but a few use first-person narration,

surrounded by much rationalizing machinery. The animal narrators, drawing from Apuleius and the Arabian Nights, often use metamorphosis as their rationale. Spirit and money narrators, drawing from popular pneumatology, frequently use cabalistic devils or familiar spirits. Object narrators, a comparatively late development, sometimes use no machinery at all.

At their high point in the eighteenth century, these novels represent a distinctive branch of the picaresque novel. Their purpose was chiefly satirical, but they contained the entire range of human emotions before the end of the century. Although the device is still used today for special effects, since 1800 its strongest form has been in children's literature.

255 pages. $3.19. Mic 55-109

LANGUAGE AND LITERATURE, CLASSICAL

AN HISTORICAL COMMENTARY ON THE SECOND BOOK OF MACROBIUS' SATURNALIA

(Publication No. 11,393)

Anna Shaw Benjamin, Ph.D.
University of Pennsylvania, 1955

Supervisor: William C. McDermott

The purpose of this work is to present a translation into English of the second book of Macrobius' Saturnalia, which consists of a collection of the witticisms of the ancients, and to study the material of this collection with a view to its historical importance. The majority of the jests deal with personalities who lived at the end of the Roman Republic and the beginning of the Augustan Empire. Chief among the personalities represented are Cicero, Augustus, and Julia whose sayings form the main body (chapters III, IV, V) of the second book.

The procedure has been to present background material necessary to an understanding of the book in sections of the introduction on Macrobius' life, the setting of the Saturnalia, the interlocutors, the symposium tradition. It was necessary to examine the sources of the sayings and to try to determine whence Macrobius compiled his book of famous sayings. In the historical commentary, procedure demanded a gathering of all references pertinent to Macrobius' work from ancient authors and the interpretations (if any) of these references from ancient writers by modern commentators.

The result of the work was the discovery that the great majority of the jests and anecdotes preserved in the second book of the Saturnalia is a part of the political propaganda of the turbulent period at the end of the Roman Republic and the beginning of the Empire, and that in this work are preserved substantial portions of anti-Caesarian, anti-Antonian, and pro-Augustan propaganda. Of outstanding importance is the fact that much of the material of the second book is known only from Macrobius, so that, while we may discount Macrobius on a literary basis as a mere imitator and compiler, we must consider the information that he presents.

Conclusions to be drawn from a study of this propaganda are that most of the anti-Augustan propaganda has been lost, probably suppressed; that the abundance of anti-Caesarian sayings well testifies to the fact that Caesar did not attempt to suppress the propaganda of the opposition and that Augustus made no effort to "whitewash" his adoptive father; that the old freedom of speech enjoyed under the Republic that is found in the outspoken manner of Cicero, vanished under the Augustan Empire.

189 pages. $2.36. MicA 55-1091

A LINGUISTIC STUDY OF THE VULGAR GREEK LIFE OF AESOP

(Publication No. 11,511)

Winifred Hager Hostetter, Ph.D.
University of Illinois, 1955

This dissertation presents a linguistic study of the version of the vulgar Greek Life of Aesop known as G contained in manuscript number 397 of the Pierpont Morgan Library and published for the first time by Professor Ben E. Perry in Aesopica volume I (1952). The main purpose of the study is to determine by reference to other documents of the Hellenistic period whether the unclassical forms and constructions which appear in G can represent the original readings of the archetype. Secondarily, Vita G is compared with W, a syncopated and stylistically altered revision of the narrative extant in several Greek manuscripts, which have been collated to produce the text of that rescension in Aesopica.

The material is presented in four chapters: Orthography, Accidence, Syntax, and Vocabulary. At the outset, letter changes, confusions, and surface corruptions in the manuscript are discussed in order to delimit the uncertainties in the linguistic analysis which are due to the seriously corrupted condition of the manuscript. Next follows a discussion of unclassical orthography retained in the emended text. Most of the forms, e.g., εὕρεμα, μηθέν, ποταπός, γίνομαι, ἔσω, are found to be well-established Hellenistic spellings of the words concerned. Matters such as psilosis, "vulgar-aspiration," and movable letters are also treated.

The declensions are well-preserved in G. Mixing is found in just twelve or fifteen scattered cases. The tendency to replace the more irregular comparative endings by -τερος -τατος is seen only in ἡδύτερον and ἀλαζονότερος. Unclassical verb forms are somewhat more frequent. The mixed forms ἤνεγκας, εἶπας, and γενάμενος, which combine a second aorist stem with the -α suffix of the first aorist, occur quite regularly for the verbs φέρω (ἤνεγκον), εἶπον, and γίγνομαι

(ἐγενόμην). The aorist infinitive ending in -αι for -εῖν, the aorist imperative in -ε for -ον, and the second person singular middle present in -σαι for -ῃ or -ει are present. There is some confusion among contract verbs. Liquid verbs, -μι verbs, the verbs οἶδα and εἰμί exhibit Hellenistic forms. In several cases augment is dropped.

Unclassical syntactical constructions are many. The "double comparative" construction is found in the text, as well as the "elative" use of the superlative, and the comparative used in place of the superlative. The more common Hellenistic uses of the pronouns, ἑαυτῶν = ἀλλήλων, ὅστις = ὅς, ποῖος = τίς, ποταπός = ποῖος, and others are richly illustrated in G. A few less common such as οἱ = αὐτῷ and τῶν = ὧν appear just once. Ἐν and εἰς are confused. Present tense is frequently used for the future or for a past tense. The perfect often appears where the aorist is expected. The subjunctive is used in independent wishes; potential optative and future temporal clauses are used without ἄν; ἕπαν, ἵνα, and ἐάν are used with the indicative. Non-final ἵνα occurs frequently in G as in other κοινή literature. In a few cases the participle is used for a finite verb. The genitive absolute construction is loosely used. There is confusion of the negative particles. Other κοινή phenomena such as ἐάν in relative clauses, εἰ introducing a direct question, and ὅτι introducing direct discourse are also present.

The vocabulary of the text exhibits the same unpretentious κοινή style which characterizes the accidence and syntax. It abounds in rare and late words, Latin words, diminutives, and words from comedy and poetry.

Evidence gathered from other Hellenistic documents shows that almost all of the unclassical forms and constructions in G, and certainly all those that occur at all frequently, can be the original readings of the archetype and (or) perhaps the work of ancient editors or copyists. The comparison with W, while not complete, leads to the conclusion that W was revised linguistically in an attempt to eliminate forms and constructions displeasing to more learned readers. The revision is, however, carelessly and incompletely done. 150 pages. $1.88. MicA 55-1092

LANGUAGE AND LITERATURE, LINGUISTICS

PROTO-MIXTECAN

(Publication No. 11,418)

Robert Edmondson Longacre, Ph.D.
University of Pennsylvania, 1955

Supervisor: Henry Hoenigswald

Mixtec, Cuicatec, Trique, and Amuzgo (Mexican Indian languages) form a genetically related group which may be termed the Mixtecan family. Mixtec, Cuicatec and Amuzgo have been so classified for some time, but Trique has usually been classified with some diffidence as belonging to the related Popolocan stock. In this study I demonstrate that Mixtec, Cuicatec, and Trique are related in roughly the same time-depth. Amuzgo is not systematically incorporated into the reconstructions, but Amuzgo forms are occasionally cited. Amuzgo appears either to be related in approximately the same time-depth as the other three languages or to reconstruct on an earlier layer. I term the reconstructions presented in this study Proto-Mixtecan with the recognition that systematic incorporation of Amuzgo will probably result in certain alterations.

The data basic to these reconstructions come from various of my colleagues of the Summer Institute of Linguistics and from my own investigation of Trique. Four Mixtec dialects, one Cuicatec dialect, and one Trique dialect with scattered citation of forms from other Trique dialects supply data for 279 sets of cognates.

Proto-Mixtecan had sixteen consonants, seven vowels, and four register tones. The consonants occurred in five series and three orders (with *ʔ outside this classification). In the following list parentheses inclose each of the five series which are respectively stops, spirants, prenasalized, nasals, and semivowels; while the first consonants in the series comprise an alveolar order, the center consonants comprise a palatal-velar order, and the last consonants comprise a labiovelar-labial order: (*t, *k, *k^w) (*Θ, *x, *x^w) (*^{n}d, *^{n}g, *$^n g^w$) (*n, *ñ, *m) (*l, *y, *w). There are two front vowels, *i, *e; three central vowels, *ɨ, *a, *ɔ; and two back vowels, *u and *o. There are certain mutual restrictions on reconstructed consonant-vowel combination; e.g., the labiovelar-labial order does not occur before back vowels.

Proto-Mixtecan forms reconstruct as *CV and *CVCV general patterns with further sub-types resulting from the occurrence of *ʔ and *m in positions where the other consonants do not occur. Proto *ʔ had the following possible positions: (1) preceding the consonant of the ultimate syllable; (2) final on the form; (3) interrupting the vowel of the final syllable. Final *ʔ is lost everywhere in Mixtec, is preserved only in some C forms, and preserved quite regularly in Trique – where it splits into *ʔ, *h and tone pattern *2-1 (< Proto-Trique high tone plus *-ʔ). Proto *-m occurred in post-vocalic position with a sub-phonemic nasalization on the preceding vowel; on loss of the final nasal the vowel nasalization became phonemic. Final *m was lost in the transition from Proto-Mixtecan to Proto-Trique, survived for a while in Proto-Mixtec, survived until a comparatively later period in Cuicatec, and is found at the present-day after certain vowels in Amuzgo.

At various points in the reconstruction of Proto-Mixtecan it is necessary to posit variant forms in the proto-language itself. These variant forms point to Proto-Mixtecan morphophonemic or grammatical alternations. For example, the frequent inconsistency

of nasalized vs. nonnasalized vowel reflexes in our cognate sets leads us to reconstruct pairs of proto-variants, one variant with final *-m and the other variant without it. Likewise the consonant of the reconstructed penultimate syllable displays two regular patterns of alternation. One such pattern, which is essentially an alternation of *y with *t or *Θ characterizes the reconstructed noun; another such pattern, consisting of the following alternating elements, *k^w, *x/ *xi/ *w/ *y, *k, and *nd/ *n characterizes the reconstructed verb.

Eight basic tone patterns reconstruct along with six additional tone patterns found only on reconstructed tone sandhi variants. The highest tone of the reconstructed tone system was restricted to such sandhi variants. 333 pages. $4.16. MicA 55-1093

LANGUAGE AND LITERATURE, MODERN

THE SWEDISH RECEPTION OF SINCLAIR LEWIS AND HIS CONTEMPORARIES

(Publication No. 11,391)

Carl L. Anderson, Ph.D.
University of Pennsylvania, 1955

Supervisor: Robert E. Spiller

The aim of this study is to examine the Swedish reception of modern American literature, particularly in the 1920's, when a complete reversal in the Swedish attitude toward American literature took place. Before 1920 Swedish critics were virtually ignorant of American literature and were scornful of all American cultural pretensions, yet in 1930 they awarded their highest literary honor, the Nobel Prize, to an American author, Sinclair Lewis.

The study is based chiefly on reviews and essays on American literature that appeared in Swedish newspapers (the chief forum for literary discussion in Sweden) and magazines. Also taken into account are books and articles on America that reflect the Swedish viewpoint before 1920 and after; the translation of all American books of fiction during the period 1916 to 1945; and the circulation of American books in Swedish lending libraries.

After defining the body of prejudices prevailing in Sweden in 1920 with respect to American culture and inherited by Swedish critics from the Norwegian Knut Hamsun and his Swedish successors (Per Hallström, Henning Berger, Gustaf Hellström, and others), the study surveys the reputation of American literature in Sweden in 1920. The chief representatives of American letters at this time were Poe, Cooper, and Twain — all regarded primarily as authors of books for children or young people— and Jack London and Upton Sinclair, the former enjoying a tremendous vogue for many years. None of these was considered worthy of serious critical attention.

Therefore, disaffected toward American culture by the animadversions of their own writers, and confirmed in their prejudices by their previous experience with American books, Swedish critics found in Lewis's Main Street and Babbitt a refreshing and authoritative corroboration of their common view of American life. So great was Lewis's reputation as an American literary rebel that other American writers that followed him were judged by the standard of well-balanced rebelliousness set especially by Babbitt. Writers such as Hergesheimer, Glasgow, and Cather were dismissed as competent and even at times excellent writers of little significance, for they either did not engage in or did not sustain a protest against American "smugness," "false idealism," etc., and therefore were not truly "modern." Although Edith Wharton was considered "modern" in this sense, her protest was regarded as too limited; Sherwood Anderson's primitivism seemed too general to make for decisive criticism of Lewis's sort. Theodore Dreiser, therefore, became Lewis's sole contender for the Nobel Prize in 1930, but as much as An American Tragedy was held to be a masterpiece of naturalistic fiction, it seemed to reveal gross naivete and serious philosophical limitations. The prize accordingly went to Lewis, although a member of the committee that made the award later stated (and others agreed with him) that it more properly should have gone to Dreiser.

The award represented the final though still not complete breakdown of the traditional barriers against American literature in Sweden, with the result that American literature could for the first time be generally read without either apology or generalized reference to the culture of origin. In succeeding years American literature came to be less exclusively read as social document and prophesy peculiar to America and more widely as one of the world literatures. The study and imitation of form and content in American literature, especially in the work of Whitman and Hemingway, were a sign of the new attitude made possible, paradoxically, chiefly through the liberating influence of Sinclair Lewis upon stereotyped Swedish views of America which his own books had seemed to confirm.

208 pages. $2.60. MicA 55-1094

THE WELL-MADE GENTLEMAN: A STUDY IN ENGLISH THEORIES OF ARISTOCRATIC EDUCATION FROM 1660 TO 1775

(Publication No. 10,855)

George Charles Brauer, Jr., Ph.D.
Princeton University, 1952

Perhaps the most important aim of aristocratic education, according to theorists of the Restoration and eighteenth century, was the inculcation of virtue. Writers advised that the gentleman be taught to control his passions by his reason and that training in virtue begin in the very cradle. Education was also supposed

to produce public spirit (a sense of duty toward society and the nation), learning, good breeding, and a knowledge of the world. All these aims were based on a concept of the ideal gentleman. In its broad outlines the ideal was the same as it had been in the Renaissance, although there were many modifications and changes of emphasis. Greater stress was laid on good breeding and a knowledge of the world, for example, and less on duty toward the state.

The aristocracy was severely criticized for not conforming to the first two components of the ideal; commentators accused the gentleman of vice and irreligion and characterized him as abysmally ignorant. Many gentlemen actually scorned learning, considering even a small degree of it inconsistent with gentility. They feared, moreover, that learning would render them pedantic and incapacitate them for taking a graceful part in the social intercourse of the polite world. To some extent the theorists shared these views, but gentlemen themselves frequently exaggerated the dangers of learning, with the result that they were in fact sometimes quite ignorant.

History and law were extremely important studies for gentlemen. Some writers questioned the traditional emphasis on Latin and decried a detailed training in grammar and the enforced composition of themes and verses. The polite accomplishments were included in the gentleman's upbringing, although he was not to devote too much time to them. Vocational training was advocated by a few commentators.

Good breeding and a knowledge of the world were the parts of the ideal most heartily endorsed by gentlemen. The former, or the art of pleasing in social intercourse, had two manifestations, the act of civility (which was universally well-bred) and the act of ceremony (which was arbitrary, local, and temporal). A well-bred act had to be adorned with a graceful manner, a charm of execution. The world was the school of good breeding, but its primary lesson was a knowledge of man and of how to conduct oneself in society, since by definition the world was society or mankind. It also afforded the gentleman useful, factual information, and it influenced him toward virtue if he consorted with virtuous company. When his companions were vicious, however, it led him to vice. Some commentators considered the world almost inevitably an evil influence.

The Grand Tour as an instrument of education was recognized as having many advantages, the most important being that it gave the gentleman practical, timely information about the Continental countries. Most theorists condemned the aristocratic practice of sending youths abroad during their later teens, for they were then too young to benefit by the tour and would only adopt vices. Other commentators depicted the Continent as almost always conducive to vice and accused it of de-Anglicizing the gentleman, making him a Frenchman and turning him against his native land.

The relative merits of public and private education were the subject of much controversy. For different reasons, supporters of each system claimed virtue as its peculiar merit. Other arguments were also advanced on either side; the schools, for example, were criticized for not adapting studies to a pupil's individual intellectual capacity and talent, and parental overindulgence was named as a disadvantage of training at home.

584 pages. $7.30. MicA 55-1095

THREE RELATED THEMES OF HUNGER AND THIRST, HOMELESSNESS, AND OBSCURITY AS SYMBOLS OF PRIVATION, RENUNCIATION, AND COMPENSATION IN THE POEMS OF EMILY DICKINSON

(Publication No. 11,260)

Lee Biggerstaff Copple, Ph.D.
University of Michigan, 1954

The purpose of this study is to examine some 250 poems by Emily Dickinson, chosen empirically on the basis of their symbols, in order to discover a) the meanings conveyed by the symbols within each work, and b) the themes or patterns which emerge when the poems are grouped on the basis of symbolism. The significance of the study lies in a) the understanding of incomplete or difficult poems which may be gained by comparing them with other poems using the same or similar imagery, and b) the insight into the peculiarly personal but imaginatively 'universal' themes in the work of a distinguished woman poet.

The thesis, to be examined by exegetical and classificatory methods, is as follows: through the related generic symbols of hunger and thirst, homelessness, and obscurity, Emily Dickinson expressed in poetry the privation which she had experienced as well as the adjustments of renunciation and compensation which she made. The privations referred to seem to be those of love, companionship, and status, but the 'autobiography' which may be deduced from these poems is a spiritual one and has no necessary point-to-point correspondence with actual biographical fact.

Considered first are the images of hunger and thirst. In themselves these are symbols of privation: "I had been hungry all the years," she says. When the desired satisfaction appears to be completely unattainable, the poet intellectually renounces it: "The banquet of abstemiousness/Surpasses that of wine." Then, from a position of detachment, she seeks emotional compensation in being 'fed': in this life she accepts Nature's "invitation broad/For whomsoever famishing/To taste her mystic bread," and she also looks forward to heavenly satiation from that "great water in the west/Termed immortality."

Dealt with next are five symbols of privation – robbery, imprisonment, banishment, coldness, and darkness – which constitute the generic symbol of 'homelessness.' The poet renounces this need for a home by deliberately choosing its antithesis in the grave – "the grave my little cottage is," a home which ironically parallels all the privations of homelessness. Compensation consists in the expected security of a heavenly home, where her loved ones will be restored in the relationship which she had

partly known but had felt to be incomplete on earth: "The faces of the atoms/If I shall see,/How more the finished creatures/Departed me!"

Discussed finally are the symbols of obscurity, or lack of status. Privation of this rank is conveyed both by diminutive comparisons – "I was a phebe, nothing more" – and by privitive statements – "Title divine is mine/The Wife without/The Sign." Status is renounced by refusing to admit its importance: "who can add a crown/To him who doth continual/ Repudiate his own?" Compensation is achieved a) through assuming the fantasy rank of wife or royalty – "I'm wife; I've finished that,/That other state; /I'm Czar, I'm woman now" –; b) by anticipating the rank which death will bring – "One dignity delays for all,/One mitred afternoon" –; and c) through looking forward to heavenly recognition – "My paradise, the fame/That they pronounce my name."

Two principal conclusions can be drawn from this study. 1) Emily Dickinson used personally meaningful although essentially conventional symbols to convey the themes of privation, renunciation, and compensation in a forceful and vivid manner. 2) Although it is impossible to determine, and largely irrelevant to know, what correspondence exists between the extremely personal tone of the poetry and the biography of the poet, Miss Dickinson has written a 'poetic' autobiography which shows great understanding of, and a dignified and worthy response to, privations which have been experienced by countless women in all ages. 181 pages. $2.26. MicA 55-1096

THE EARLY LIFE AND LITERARY CAREER OF WILKIE COLLINS

(Publication No. 11,497)

Nuel Pharr Davis, Ph.D.
University of Illinois, 1955

The prodigious success of The Woman in White was the first pinnacle of Wilkie Collins's career. He reached it by a journey of many stages. His father, a Royal Academician, communicated to him a love of the arts but surfeited him with the obsequious toryism which aristocrats then took for granted in their dependents. Escape from school to Italy in his twelfth year infected him with permanent xenomania. Prevented by poor eyesight from becoming an artist, he applied his father's technique of figure painting to written narrative and produced the historical novel Antonina. Apprenticeship to a pious tea-merchant disillusioned him with middle-class virtues. Visits to Paris established the theater as his first love. The moribund condition of the stage in England caused him to invent in Basil a new genre, the narrative drama or sensation novel. Dickens taught him the appeal of the familiar and disciplined him in the conciseness of the true professional writer. He in turn taught Dickens a basically new conception of unity in plot and was more responsible than any one else for the trend of Dickens's later works beginning with Little Dorrit. The interplay of ideas between the two is unexampled among other writers of fiction in English. In 1856 Dickens commissioned him to write a novel for the magazine Household Words. In the resulting Dead Secret, though it is imperfect when viewed as a whole, Wilkie showed that he could surpass Dickens in ability to develop a novel in parts for instalment publication. Both men were moving away from the evangelicalism implicit in much Victorian literature. Wilkie had a theory of the Actual derived ultimately from his father's methods of observation as a painter. This led him to take note of such unsavory social phenomena as the courts, police, and asylums. He was an atheist, a man sensitive to suffering, and though an Englishman, an Anglophobe. In the procedures of the courts he believed he had come upon a scheme for the analysis of behavior by a new set of values. In 1859 he constructed The Woman in White as a series of testimonies by diverse witnesses.

Victorians were both fascinated and repelled by his seeming bad taste and his purely secular outlook. The Woman in White started the school of the roman policier in France, England, and America. It also set up standards of sharpness and objectivity in backgrounds that novelists in general have since been forced to try to maintain.

323 pages. $4.04. Mic 55-110

EDWIN ARLINGTON ROBINSON AND ALANSON TUCKER SCHUMANN: A STUDY IN INFLUENCES

(Publication No. 11,401)

Peter Dechert, Ph.D.
University of Pennsylvania, 1955

Supervisor: Sculley Bradley

The existence of a large quantity of manuscript poetry by Alanson Tucker Schumann, in the possession of the Gardiner, Maine, Public Library, is not generally known. Since Robinson himself wrote of Schumann that "I shall never know the extent of my indebtedness to his interest and belief in my work, or to my unconscious absorption of his technical enthusiasm," it was considered that a comparative study of the poetry written during their association would be valuable.

It is hard to date Schumann's poems exactly, but letters between him and Robinson show that the two were exchanging poems from Robinson's very early beginnings until after 1911. Thus, a study of Schumann's characteristic techniques, attitudes, and subjects was prepared and compared to similar aspects of the early work of Robinson.

The results indicate that Robinson's debt to Schumann was considerable in severay ways. First, he adopted many of Schumann's theories and practices of technique, especially in the sonnet form. Second, he was early influenced by Schumann's view of the role of poet, what the poet should think and do; this influence was neither so strong nor so lasting as the

first, however. Finally, Robinson was influenced philosophically by certain of the attitudes toward life which Schumann professed.

Further results indicate that Schumann directly influenced Robinson's youthful reading of many older and contemporary poets. Like Robinson, Schumann wrote sonnets of appreciation of these figures. Schumann also wrote poems which point toward Robinson's Tilbury Town vignettes. And many of his "Quatrains" may point toward the "Octaves" written by Robinson after the shock of his mother's death.

Schuman was far from being a great poet. His verse is largely bad, though his technique is extremely facile. Despite his shortcomings, nevertheless, his influence on the younger poet over the years of his coming of age was considerable, both in the realms of technique and outlook.

225 pages. $2.81. MicA 55-1097

THE CREATIVE PROCESS IN ART AND CRITICISM ACCORDING TO DIDEROT

(Publication No. 10,884)

James Doolittle, Ph.D.
Princeton University, 1948

The 18th century is a period relatively barren of authentic artistic production in France. Standing between the supreme achievement of neo-classic poetry in Racine and the great outpouring of artistic energy which is to begin early in the 19th century, it is a time of transition and revaluation. The major preoccupation of its foremost writers is one more of scientific investigation and experiment than of artistic accomplishment; the scientific curiosity of these men and women extends to all fields, considers all things and endeavors as phenomena, and seeks rather to explain that which exists than to create that which does not yet exist. Made acutely conscious of their ignorance by the enlightenment brought about in their time by the great strides of progress in the sciences, the best of 18th century minds pause to discover what is about them in order then to go more surely to levels of achievement and well-being as yet only dreamed of. Like all other natural and human phenomena, the arts are subjected to their scrutiny.

The Encyclopédie is the epitome in form of this intellectual and moral climate, and the works of Denis Diderot, its guiding spirit, provide an intimate picture of the multifarious interests and efforts of the mind and soul that produced the Encyclopédie. Among all the phenomena which he was called upon to examine, it was man who most surely captured his imagination and to whom his attention was most frequently and willingly turned. And in the field of human endeavor literature and the fine arts were the products whose nature and origin provoked his most enthusiastic investigation.

Diderot is always careful to consider the artist apart from the work of art. The work of art is for him but the outward manifestation of the inner workings of a particular man who, by the very fact that he has produced a work of art, is an extraordinary individual and therefore the more interesting. The artist is by definition a man of genius, and if Diderot is often profoundly concerned with human psychology in general, his curiosity inevitably carries him on to consider the genius in particular.

Diderot's universe is made up exclusively of matter and its attributes. Man represents a particular conformation of certain material elements, and genius is the result of an accidental proportioning of those elements. Genius is thus a gift of nature which, properly trained and refined, is alone capable of successful creative effort in any field of endeavor.

Specifically, the psycho-physiological equipment of the man of genius must consist of an indefinable proportioning of three principal endowments; a keen, highly trained intelligence; a strong imagination; an acute and active sensory apparatus, to which are joined energetic passions. This is the mechanism by which forms in nature are transmuted into imitated forms which constitute works of art.

The process by which a work of art is created through the mechanism of genius may be variously described as a transfer of energy, a transmutation of form, a translation of meaning. All matter exerts energy. The exertion of energy is perceived by the human observer to relate one object or quality to another. Awareness of form is the perception of a structure of such relationships. The association of a quantity of structures in the intellect or the imagination of the observer leads him to draw conclusions as to the meaning of forms in nature and thus, by experiment, analogy, or both, to build a conception of the meaning, the truth, of the whole of nature. The function of art is to translate the truth of nature perceived by the insight of genius into terms comprehensible to an ordinarily intelligent apprehender.

The creative process which takes place in the artist consists of three principal steps. The first is the artist's perception and contemplation of a basic idea, a portion of natural truth. This contemplation arouses "enthousiasme," which is passionate energy and which stimulates the artist's imagination into activity. The second step includes the imaginative activity, which casts the artist's inner state into the form of images. The images thus created constitute the "inner model" in accordance with which the work of art is to be produced. The third step includes the ordering of the images and their expression through a physical medium into exterior form, which is the finished work of art. Thus, while the work of art is indeed in a sense an imitation of forms in nature, it is more precisely patterned after forms transmuted in the imagination of the creative genius in such a way as to reveal his individual perception of the truth of nature.

The critic is conceived of as going through the identical process to produce his interpretation of the work of art, except that his starting point is necessarily the artist's expression rather than the original form in nature. Since Diderot's principal interest is directed upon the inner activity of both artist and critic, and since he believes that only genius can fully appreciate genius, his critic's task is as much a work

of creation as is that of the artist, and it is inevitable that the work of the critic must eventually become indistinguishable in its nature from the work of the artist.

It is in the work of the artist-critic, finally, that the traditional limits of artistic endeavor are transcended and destroyed, and that the scientific world-view which dominates the 18th century is to find at last a fully adapted means of artistic expression in the novel of the 19th century.

201 pages. $2.51. MicA 55-1098

LA DÉCADE PHILOSOPHIQUE: A STUDY IN LITERARY THEORY AND CRITICISM

(Publication No. 10,937)

Richard Knowlton Kellenberger, Ph.D.
Princeton University, 1947

The aim of this thesis is to present, analyze and evaluate the literary theories and the critical opinions expressed in oneof France's most interesting Journals, La Décade philosophique, which was published from April, 1794, to September, 1807. It is concerned primarily with the critical methods used in the journal, that is, with the basic principles or criteria with which literary works are judged. Through a careful comparison with the methods of traditional neo-classic criticism it aims to determine to what an extent the critics of the Décade succeeded in fermulating and in practicing a new type of criticism. It aims further to study close at hand the intricate course that literature followed in its gradual evolution from the neo-classic school of the Eighteenth Century to the "New Literature" of Chateaubriand of the Nineteenth Century.

The critical opinions of the journal are arranged in chronological order, and thus present a survey of literature from the epics of Homer to the works of Chateaubriand. Works dealing with purely philosophical and scientific matters are excluded, and the discussion of foreign literatures is limited to only those authors who particularly interested the Décade or who were of particular importance because of their influence upon French literature. Considerable attention is given to the program for a republican literature that the journal supported prior to 1800 and that it later repudiated. The journal's theories concerning the nature of the most important literary genres – tragedy, comedy, drame, melodrame, poetry, novel and criticism – together with its criticism of specific contemporary authors of each genre are discussed with reference to traditional and modern points of view to determine the significance of its contribution to literary criticism. The study concludes with an analysis of the journal's attitude towards the critical works of La Harpe, Geoffroy, Mme de Staël and Chateaubriand. In the appendices are included a catalogue of novels reviewed by the Décade and a detailed study of the stylistic criticism made of Chateaubriand's Génie du Christianism.

The study concludes that there were three general critical approaches to literature practiced in the Décade: the neo-classical, the republican, and the comparative, that the critics gave expression to ideas and opinions that suggest all three of the major schools of literature, the neo-classic, the romantic and the realistic; that its two leading critics, Pierre-Louis Ginguené and Claude Fauriel, made use of an historical and comparative method of criticism that anticipated that of Sainte-Beuve and Brunetière of the following century. 600 pages. $7.50. MicA 55-1099

LOUIS JOUVET

(Publication No. 11,461)

Bettina Liebowitz Knapp, Ph.D.
Columbia University, 1955

Jouvet, born in 1887 in Crozon, France, found the path to theatrical fame fraught with difficulties. As a youth, he had to overcome not only family objections to a theatrical career but also physical disabilities as well. He was a stutterer, ungainly in appearance and awkward in movement. At first he ostensibly gave in to family objections to a theatrical career by studying pharmacy at their behest. It did not take long, however, before Jouvet turned to the stage. His physical handicaps were ultimately conquered by a combination of sheer perseverance, hard work and the influence of such friends as Leloir, Noel, Rouché and Copeau.

In 1913 Jouvet began his first real theatrical apprenticeship when he joined the Vieux-Colombier. There he worked with Jacques Copeau and learned the rudiments of acting. He played all types of roles from the comics of Molière to the debauched of Dostoievsky. He also worked as scene painter, mechanic, light manipulator and decorator, eventually inventing the lighting device known as Les Jouvets.

Jouvet's contributions as a director were first made at the Comédie des Champs-Elysées of which he became Director in 1924. Here he produced such noteworthy and successful plays as Romains' Knock and M.Le Trouhadec saisi par la débauche. He also suffered reverses in the Quintero brothers' L'Amour qui passe and Crommelynck's Tripes d'Or. More important, though, Jouvet discovered and introduced the playwright, Giraudoux, to French audiences. It was in Giraudoux's Siegfried, Amphitryon and Intermezzo that Jouvet found the vehicles to introduce to acting a method of incanatory speech.

In the mid-thirties, Jouvet reintroduced Moliere's L'Ecole des Femmes in its original text. His abilities were so well recognized at this time that he soon became a Professor at the Conservatoire. There he dedicated himself to instilling great love and knowledge of the French theatre in his students so as to provide a ready reservoir of talent for future French productions. His approach was eclectic. He laid down not set rules to follow; he offered no magic formulae. He counseled reliance on one's intelligence, experience and intuition to resolve the play's problems.

During World War II, Jouvet toured South America under great physical and moral handicaps. Upon his

return to Paris in 1945, he found himself regarded as a "has-been." He met the challenge by a successful production of La Folle de Chaillot. In a sense, he alone restored himself to his former position of eminence in French theatrical circles; for, Giraudoux, his friend and collaborator of many years, had died several years earlier. It was also at this time that Jouvet turned to Molière for inspiration and satisfaction. Molière seemed to suit Jouvet both spiritually and dramatically and his productions of Molière's Dom Juan, Les Fourberies de Scapin and Tartuffe were highly personalized interpretations.

Death claimed Jouvet on August 21, 1951 shortly after he had finished directing Sartre's Le Diable et le bon Dieu. Jouvet's utter devotion to the theatre, his qualities of character, his readiness to experiment, his non-rigid approach to acting and directing make his career a fitting example for others to emulate. In his way, Jouvet enriched the repertoire theatre of France by his acting, his directing, his interpretations, his lighting techniques, his discovery and development of unknown and untried dramatists and his resurrection of the classics.

395 pages. $4.94. Mic 55-111

ERNEST RENAN AND THE JEWISH WORLD

(Publication No. 11,463)

Elvin Irving Kose, Ph.D.
Columbia University, 1955

Renan's reputation as one of the most influential figures in nineteenth century thought lies mainly in his pioneering efforts to apply rational, scientific methods to the study of Christianity, its origin, genesis, and subsequent development. This research led him as well to a study of Jewish life and thought from biblical times up to and including the nineteenth century.

While his Jewish studies were corollary to his main purpose, they are significant in evaluating Renan's position as an authority on Judaica as well as the influence of these attitudes on western European opinion.

The first chapter of this work traces Renan's views on race, as a factor in civilization. He felt that language was the basis for uncovering the early roots and subsequent traits of a people or a group. Consequently, he classifies Hebrew, the language of the Jews, with the Semitic group, which in comparison to the Indo-European or Aryan peoples was vastly inferior in virtually all areas of human creativity. Renan felt that Semitism had been, and still was in his day, a stifling element in human progress that must be fought and suppressed if mankind is to attain its fullest potential. In his later years, however, Renan modified his emphasis upon race as a major factor in history and stressed rather the common purpose of all enlightened seekers after rational truth.

Chapter two discusses Renan's opinion on modern Jews. He does not consider them as members of the Semitic race. They are, at best, liberal Europeans devoted to the betterment of society based on scientific research.

Less sympathetic treatment is granted other modern Jewish types, among whom we find the parasitic Jew, the eternal alien, the vestigial Semite, and the warped talmudist. These latter characterizations helped to provide a pseudo-scientific rationale for later anti-Semites who selected from Renan's pronouncement those evaluations that suited their purpose. At the same time liberals, Jews included, held up Renan's broad humanitarian statements as being truly representative of his fundamental outlook.

The third chapter deals with Renan's approach to the Jewish religion. On this subject, too, Renan assumes two positions. His earlier views stress the inferiority of Jewish monotheistic belief and he claims that Christianity broke decisively with the spirit and teachings of Judaism. In later years he revises this view and states that the Jewish religion was the absolute in religious expression, brought to its fulfillment through Christianity. These evolving views also held true in Renan's comparison of Judaism at the birth of Christianity and its later development in the middle ages. With the advent of Christianity, the Jews, he felt, lost their vitality and had no further purpose in the development of civilization. Yet when he studied the medieval period, he portrayed the Jew as the vigorous agent who carried the scientific spirit in the face of a petrified Christianity.

Jewish scholarly influence on Renan's views is most apparent in his medieval studies. Jewish colleagues in France and Germany were the leading authorities in this area of research and Renan, who incorporated their findings into his larger works, circulated this knowledge among a wider audience. The subject of Jewish influence on Renan is discussed in chapter four.

Finally, Chapter five reviews Jewish opinions of Renan's work. Critics, ranging from strong hostility to sympathetic praise, reflect both the diversity of Jewish viewpoints and the contradictory nature of much of Renan's work.

209 pages. $2.61. MicA 55-1100

THE-BOOK-OF-THE-MONTH CLUB: THE STORY OF A PUBLISHING INSTITUTION

(Publication No. 11,415)

Charles Lee, Ph.D.
University of Pennsylvania, 1955

Supervisor: Sculley Bradley

The purpose of this thesis has been to set forth the history of the Book-of-the-Month Club, to examine the procedures by which it operates, to inquiry into the nature of its membership, and to analyze its effect upon the sales of books in the bookstores.

The thesis is divided into two main sections, Chronicle and Procedures and Membership.

Part I, Chronicle, traces the origin of the Club in the business experience of its principal founder,

Harry Scherman. It details the Club's development in the face of certain industry hostilities, explains the strategies by which it overcame the depression (particularly, the Club's own manufacturing arrangements and Scherman's invention of the Book-Dividend Fund), and follows its progress through the economic stresses of the war. An account of its promotional activities and its many subsidiary developments (such as Metropolitan Miniatures, Young Readers of America, and Books Abridged) is integrated with the narrative. Statistics are offered to defend the conclusion that its effects on the sale of books in bookstores and the quality of best-sellers have been beneficial.

Part III, Procedures and Membership, examines in detail the editorial process by which books-of-the-month are selected, the manufacturing process by which they are produced, and the advertising process by which they are sold. The membership is analyzed with respect to age, education, sex, and geographical location.

Four appendices conclude the thesis. These present the complete list by year (1926-1953) of the Club's selections, dividends, and alternates, as well as a substantial number of estimates of the value of the Club by reviewers, critics, and publishers.

254 pages. $3.18. MicA 55-1101

MATTHEW ARNOLD'S POETIC THEORY: A HISTORY

(Publication No. 10,952)

Robert Liddell Lowe, Ph.D.
Princeton University, 1947

This dissertation is a history of Matthew Arnold's poetic theory; the chronological consideration of his theory proves that Arnold had all his basic ideas on poetry before he published his first critical document, the Preface to Poems (1853). The Preface itself and all Arnold's other essays on poetry are a restatement of these ideas in a different setting.

Chapter I, which examines his theory from 1845 to 1853, presents him as a poet writing to a poet; here he is more concerned with what poetry is, as opposed to his later role of the sociological critic primarily concerned with what poetry does for us. Nurtured on Homer, Sophocles, Milton, and Wordsworth, he renounces the subjectivism and formlessness of contemporary poetry. Preoccupied with the need for integration in disparate times, he believes that without personal integration the poet will produce a fragmentary poetry. In an anticipation of his famous dictum that poetry is a criticism of life, he insists that the poet have an "Idea of the world" if he is not to be prevailed over by the world's multitudinousness. He demands careful attention to form and asks for a style that is classical in its plainness, directness, and severity because a poetry that has to interpret the complex nineteenth century cannot afford to lose itself in ornament, as Elizabethan poetry did, but must press forwards to the whole. Arnold is already mindful of the relation between the character of a poet and his work, of the ennobling effect of the grand style on the reader, and of the relation between the poet and his age.

During this period one significant change occurs in his theory. After the publication of Empedocles on Etna (1852), which Arnold found dolorous and monotonous, he insists that the function of poetry is to inspirit the reader. He also begins to place more emphasis on the content of poetry. Modern poetry, he says, can subsist only by becoming a "complete magister vitae as the poetry of the ancients did: by including, as theirs did, religion with poetry." Poetry, then, must synthesize all human endeavor in an integrated pattern, and the implication is that it must take the place of religion.

Chapter II is a study of the Preface of 1853. As a poet speaking to poets, Arnold attacks the subjective poetry of the day and directs the poet to choose for narrative and dramatic verse a noble action and to imitate the ancients in structure and expression to avoid triviality and formlessness. Poetry, he insists, is dedicated to joy. Great poetry leaves us with a profound moral impression; its effect upon us is akin to that of religious emotion.

Chapter III considers the critical poems in The Strayed Reveller (1849) and Empedocles on Etna, and shows how the ideas in these poems are congruent with the theory in his correspondence.

Chapter IV covers the years from 1857 to 1867. With his Inaugural Lecture as Professor of Poetry at Oxford there is a great change in his function as a critic of poetry, but not in his ideas on poetry. His concern is now with what poetry can do for us. Hereafter he is rarely the poet speaking to poets. His audience becomes the English middle class in need of direction in all avenues of life, and he sends them to the great poetry of Greece for what he calls intellectual deliverance. The lectures On Translating Homer, though addressed to the future translators of the Iliad, also have sociological implications; the sanity of Homer can help to cure modern Englishmen of their caprice. As Arnold becomes the sociological critic, he naturally turns to the relation of the poet and the modern world. He is now more sympathetic with some of the Romantics, but rather as men who fought against an impossible social order than as artists. He is concerned with the problem of how the uninformed English poet can understand his own disorganized times well enough to interpret them with partial adequacy.

Chapter V examines Arnold's remaining poetic criticism, when he was primarily a sociological and religious critic. From 1867 until his death in 1888, he considers literature as an agency "depending upon and supporting other social agencies." As the agency of formal Christianity weakens, Arnold more and more relies upon the great poets of the Western World to reconcile him and mankind to the pressures of life.

445 pages. $5.56. MicA 55-1102

LAS IDEAS MORALES EN LAS "NOVELAS ESPAÑOLAS CONTEMPORÁNEAS" DE GALDÓS

(Publication No. 11,526)

John Albert Pettit, Ph.D.
University of Illinois, 1955

Don Benito Pérez Galdós es el escritor más destacado de la literatura española del siglo XIX. Dentro de su voluminosa producción literaria, la serie de las Novelas españolas contemporáneas ocupa el puesto central. En estas novelas sociales, presenta un cuadro crítico de la sociedad que revela el decaimiento y el atraso de España, y expone sus ideas sobre el problema de la reforma nacional. Dedica sus obras a la consideración de temas sociales, económicos, políticos y filosóficos con el propósito de enseñar a su generación la verdad de que la regeneración social del país es esencialmente un problema moral. Una investigación de las ideas morales expresadas por Galdós en sus obras puede dar una idea clara de su intención idealista de utilizar la novela para despertar la conciencia nacional y para señalar al pueblo español la necesidad de emplear buenos principios morales para lograr el mejoramiento social de la patria.

Las diez novelas publicadas entre 1881 y 1889 proveen una amplia y representativa exposición del pensamiento sociológico de Galdós. El análisis de estas obras demuestra las ideas morales expuestas en su tratamiento de cuatro temas predilectos: el matrimonio, la educación, la política y el materialismo. Es posible juzgarle como pensador y como moralista a base de lo que dice en sus novelas.

Galdós emplea el matrimonio en Madrid para criticar las condiciones malsanas en la vida social privada de la época. El frecuente adulterio que indica el fracaso de los matrimonios presentados, es evidencia de la corrupción moral corriente en las costumbres del pueblo. La sociedad acepta teóricamente buenos principios morales que no observa en la práctica. La hipocresía social aumenta la debilidad natural de los individuos, y es una causa principal de la flaqueza nacional. La sociedad debe librarse de normas falsas y de la mentira.

La educación inadecuada del pueblo español es una causa importante de la postración del país. El sistema educativo tradicional falla en preparar a los jóvenes para la vida práctica moderna. Las escuelas no dan más que instrucción anticuada y superficial. No desarrollan la capacidad intelectual y espiritual de los alumnos. Hace falta un programa de educación pública libre interesado en la formación de hombres y de mujeres de carácter sólido basado en buenos principios morales. El porvenir de la nación depende de enseñar a toda la juventud a trabajar concertada y efectivamente por el bienestar económico-social de todo el pueblo.

En la política, España es víctima de un sistema burocrático que fomenta la corrupción y la immoralidad de hombres egoístas de todos los partidos. Los males políticos perduran a pesar de los nobles ideales predicados por los que proponen la reforma social. La experiencia demuestra que la regeneración social no puede venir por medio de cambios políticos revolucionarios, sino por medio de cambios en el pensamiento y en la conducta de los políticos mismos que ejercen el poder y determinan las prácticas del gobierno. La reforma política espera un proceso de reforma y de regeneración humana: sólo individuos morales pueden asegurar un gobierno bueno.

El materialismo de la edad moderna aumenta visiblemente la prosperidad del pueblo madrileño. El lujo y las comodidades de la riqueza corrompen el sentido moral de la gente. La sociedad adopta el ideal falso de que el único éxito en la vida es tener mucho dinero y lucirse en la sociedad. La vida sensual, frívola y estéril de las clases altas es un indicio claro de los malos resultados de la filosofía materialista exagerada en causar la decadencia y la corrupción de las costumbres sociales de la cuidad. La abundacia de cosas materiales no basta para mejorar el carácter de los seres humanos.

En todo su análisis crítico del problema social de España, Galdós llega a la misma conclusión: las malas condiciones son el resultado de la falta de moralidad privada y pública en la población española.

275 pages. $3.44. MicA 55-1103

ROBERT BLAIR AND THE GRAVE

(Publication No. 11,431)

Thomas Rogers, Ph.D.
University of Pennsylvania, 1955

Supervisor: Maurice Johnson

Although The Grave has been regarded as an expression of the private melancholy of the Scottish minister who wrote it, he intended it to be a warning for a "licentious age" to learn to die. To dramatize his point, Blair insisted on the horror of the grave at considerable length and almost to the exclusion of the proper hero of the poem, the "good man" whose end is peace; but it is clear that the poet belonged with Tillotson, Sherlock, Norris, Addison and other English preachers and writers of the late seventeenth and early eighteenth centuries in his emphasis on learning to die a Christian death rather than live an Epicurean life. It was St. Evremond who recommended the latter to Englishmen who wanted to become honnêtes hommes and ignore the threat of the grave.

Blair wrote the separate verse paragraphs of The Grave with a vigor and strength that give the poem a style of its own, but lack of balance weakens the effect of the work as a whole. The language of the poem exhibits Blair's familiarity with the writings of Shakespeare, Dryden, and John Norris, among others; and the first edition of The Grave (1743) is given here with notes to show such literary parallels, variant readings, and special meanings in the text. It was Blair's misfortune that his deliberate exploiting of the fear of death lost his poem the approbation of

Dr. Johnson, whose Vanity of Human Wishes is in other respects like The Grave.

Blair's letters proclaim his devotion to "plain, serious, and affectionate preaching," reveal his friendship with the celebrated Christian convert Colonel James Gardiner, and suggest the tenor of life in the manse at Athelstaneford. His testament dative shows the minister as a small farmer and moneylender and contains an inventory of his microscope and the books in his library. His scientific and literary tastes put him at some distance from his grandfather, Robert Blair of St. Andrews, a Covenanter who wrestled with spirits and zealously burned a copy of Petronius; but The Grave itself is not unworthy of the strong Kirkly tradition of the Blairs.

331 pages. $4.14. MicA 55-1104

THE USE OF 'DINGE' IN THE CREATIVE ART OF ADALBERT STIFTER

(Publication No. 11,020)

Henry Herman Schneider, III, Ph.D.
Princeton University, 1948

The purpose of this dissertation has been to present an evaluation of the significances of those elements contained in the creative writings of Adalbert Stifter which may best be called 'Dinge,' and to determine the extent to which the author's own philosophy of life is reflected in the values which he attaches to them.

The term 'Dinge' has been used to include those objects, animate as well as inanimate, natural as well as man-made, existing in the environments of Stifter's characters, with which those characters come into intimate, frequent and significant contact. It was discovered that the natural objects represented all three kingdoms, animal, plant and mineral, the last two most frequently, whereas the man-made objects represented primarily the field of artistic creation.

The values which objects were found to have for Stifter's characters and which were given significant expression by him have been classified as aesthetic, scientific, spiritual, philosophical, practical, historical and sentimental. Of these values, the first four occurred most frequently and with most significance.

Stifter's works have been treated chronologically within three sections, entitled 'Studien,' 'Erzählungen' and 'Romane.' The 'Bunte Steine,' 'Witiko' and several of the 'Studien' and 'Erzählungen' have been omitted either because they offered no material contribution to the subject at hand or because the little they might have contributed was repetitious of material contained in other works and given more significant expression there.

In analyzing the value which objects possess for Stifter's characters, certain conclusions have been drawn with respect to his philosophy of life. Stifter believes the ideal man to be the whole man ('der ganze Mensch') in whom are combined a balanced and maximum development of intellectual and spiritual capacities and by whom these are given expression in a full life. This development is to be achieved through a close association of the individual with both the human beings and the objects ('Dinge') in his environment and through a full appreciation of the values contained in them.

Stifter presents nature as a model for man's emulation. He indicates the contrasts which generally exist between most of man's behavior and creations and nature. Whereas the former all too often reflect passion, transciency, artificiality, spasmodic development, guilt and infidelity, the latter exhibits serenity, permanence, truth, gradual change, innocence and loyalty.

The moral law (Sittengesetz) is for Stifter the counterpart in human society to the universal law (sanftes Gesetz) in nature. However, man must make real the former through his own actions, whereas nature exhibits the latter automatically. Man, endowed with reason, is potentially superior to the rest of nature, but he has the responsibility of developing and employing his reason in such a way as to ensure his moral behavior, if he is to justify his superior position in the hierarchy of divine creations. The nobler emotions are considered just as important as reason but man must ensure the development of only the nobler expressions of feeling by using reason to keep the baser impulses in his nature submerged.

Stifter sees in a close association with natural objects a valuable activity for the individual which will yield benefits contributing to the fuller development of that individual. At the same time, Stifter sees an association with the noblest creations of man to be of equal value, and he sees the latter to exist in the field of the creative arts, which he believes to be the one in which man most closely approximates the qualities inherent in nature.

Although no definite progressive development of Stifter's general philosophy of life was easily determinable, many of his convictions being fixed already in his early writings, there does exist a certain broadening of the sphere of activity in which the self-development of the individual finds expression and purpose. Thus, whereas in the earlier works Stifter is primarily interested in depicting the development of the individual for his own sake, in his later works Stifter advocates the expression of the individual's self-development in society to include the benefitting of his fellow-men through example, education and humanitarian contributions of material, intellectual and spiritual nature.

As a result of the study of Stifter's writings from the aspect treated in this dissertation, it has been concluded that his place in the literary tradition is primarily that of a preserver and continuer of the 'Schönheitsideal' and 'Humanitätsideal' of the German classicists, notably Lessing, Herder, Goethe and Schiller. 176 pages. $2.20. MicA 55-1105

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

THE FIGURE OF THE MUSICIAN IN GERMAN LITERATURE FROM ROMANTICISM TO THE PRESENT

(Publication No. 11,022)

George Clarence Schoolfield, Ph.D.
Princeton University, 1949

The purpose of this dissertation has been to discuss the musician in German literature from Romanticism to the present. For the most part only literary works of the first rank have been considered; however certain works of A. E. Brachvogel and Scheffel have been included because of their great popular success, and Franz Werfel's Verdi has been treated as a single example of the vie romancée. Also, none of the works mentioned in Chapter Three can be said to reach a high standard of excellence; yet all their authors have a relatively respected position in German literature.

An attempt has been made to treat the important types of the musician: the composer, the virtuoso, the mentor, the Spielmann, and the woman musician. Each of these types is considered as it appears in the four periods under discussion: Romanticism, Biedermeier and Poetic Realism, the period from the death of Wagner to the First World War, and that from 1920 to the present. The creative musician is given the most thorough examination. Before Romanticism the composer had been considered as an artisan, although of a high type; with Romanticism he becomes a "genius," an artist set apart from society, who regards himself as a kind of priest. This religious conception of his calling sets him in sharp contrast with his surroundings; he seeks consolation in the musical ideal, which is generally embodied in the person of a woman. In Biedermeier and Poetic Realism the composer is not treated as a contemporary figure; he appears only in historical dress; at the end of this period the musician as "genius" or as a "demonic" figure (an individual possessed by a δαίμων, either good or bad) is given theoretical justification by Nietzsche. In the subsequent period Nietzsche's theories (and Wagner's example) are employed to grant the musical genius the right of completely free behavior; the result is that the musician per se is forgotten while his psychoanalytical aberrations are considered in detail. In the present period various solutions are offered. Hermann Hesse desires a return to the conception of the musician as a pedagogue and music as a pedagogical means, a theme to be found in Goethe and Stifter. Thomas Mann uses the Romantic conception of the composer to symbolize the fate of the German people, as well as to express his pessimism concerning the future of modern art. Mann is the first author since E. T. A. Hoffman to approach contemporary musical problems; all intervening writers have remained extremely conservative in their attitude toward musical progress. The artist of Biedermeier and Poetic Realism is musically a classicist, the literary contemporary of Strauss, Debussy, and Stravinsky a devotee of the Wagner of Tristan and Die Meistersinger.

Romanticism demonstrates the greatest wealth of other types of the musician. The virtuoso and the mentor possess a tendency toward evil, since they employ music to their own selfish ends. The wandering musician falls into two types: if a German he is a guileless individual whose worst fault is his Wanderlust, if an Italian (or a gypsy) he is a petty criminal. In the next period the virtuoso is given legendary form and becomes completely evil. The Spielmann may be given an evil connotation (as in Keller where he is also regarded as a sociological problem) or may remain an innocent vagabond (as in Scheffel). The incapable musician, primarily a sociological or pedagogical rather than an artistic problem, is also to be found in this period; he might be said to be Biedermeier's peculiar contribution to the literature on the musician. In the nineties the evil mentor (a Svengali-type) comes into prominence once more; the virtuoso however is parodied. The Spielmann-type disappears, except for isolated and belated attempts to revive the problem of the déclassé musician and his attempts to enter society; the musician had in actuality long since left his inferior social position. The period from the first World War to the present does not offer a thorough treatment of any of these less important types; they all appear in Mann's Doktor Faustus but are subordinated to the principal figure of the creative musician. As for the woman musician, her appearance is relatively rare: during Romanticism she appears as the pale ideal (except for the immoral Italian singers), in Biedermeier and Poetic Realism she renounces her artistic career for a domestic life. In the nineties she becomes of greater interest because of her psychological problems, but after the First World War she disappears once more. However the woman as musical inspiration is treated thoroughly, if ironically, by Mann.

Romanticism presents the greatest variety of musical figures (including the archetype of the composer, E. T. A. Hoffmann's Kreisler) and stands closest to musical developments contemporary with it. Biedermeier and Poetic Realism react against Romanticism, ignoring the "demonic" musician or treating him as completely evil. They are out of touch with musical progress and regard the musician as a legendary or historical figure. The next period exploits the Romantic conception of the musical genius to its own sensational ends: musically it remains in the Wagnerian period. At present the musician is treated as a "neo-Romantic" figure (with contemporary implications) or as a pedagogue, not a creator.

436 pages. $5.45. MicA 55-1106

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

A BRITISH IMAGE OF AMERICA: A SURVEY OF AMERICA AND THE AMERICANS AS THEY APPEARED IN THE ENGLISH NOVEL, 1830 - 1890

(Publication No. 11,025)

Charles Edward Shain, Ph.D.
Princeton University, 1949

Victorian England's great literary staple, the novel, contains a lively reflection of British interest in America. Seventy-five novels and thirty-five novelists have been chosen in this study to represent significant fictional treatments of American themes and characters over six decades. Studying the novelists individually makes clear the extent and complexion of their interest in the United States and contributes to the growing body of knowledge about Anglo-American cultural relations in the 19th century.

The first four chapters of the thesis review the novels from 1830 to the beginning of the Civil War; the last three chapters include the novels of the War years and the three succeeding decades. Chapter One introduces the reader to the era of bad feeling between the two countries which reached a peak in England during the debates on the Reform Bill of 1832 when the American political "experiment" was called upon to furnish evidence of social degeneracy to which a full democracy was prone. Sam Slick, and the Westerners and Yankees of the comic books and plays contributed the first popular American stereotype of the pre-War years and passed easily into the fictional satires. Chapter Two describes John Galt's transatlantic novels and stories. His was the only fiction which ran counter to the prevailing anti-American currents, for he had a devoted interest in British emigration to America and used his utilitarian, non-political novels to display the opportunities awaiting settlers on the frontier. Chapter Three describes the four American novels of Mrs. Trollope, and Charles Dickens's abusive picture of America in Martin Chuzzlewit as the most influential documents in the "Wave of Satire" of the 30's and 40's. Mrs. Trollope's cleverest American story, Jonathan Jefferson Whitlaw, was an important and widely-read anti-slavery novel. Dickens dramatized the personal bitterness and disillusionment that resulted from his American tour. The Playfair Papers, a colorful satire of America in 1841, makes social history into implausible fiction but shows admirably the temper of the times. In Chapter Four are collected novels by Bulwer Lytton, Kingsley and Lever. Bulwer and Kingsley wrote the first fictional warnings against the threatening Americanization of England. They both saw American morality manifested in the Manchester School of laissez-faire economy and depicted as "American" social and political attempts to cut the organic filaments which bound the British classes together. Charles Lever wrote the first description of the lehrjahre of the retired American businessman in Europe.

Chapters Five and Six describe the Civil War in the novel and the British reactions to the "new" country which emerged from the War. British neutrality during the War rested in a center of indifference and disillusion which the earlier novels had been influential in establishing. Tory novelists like Ouida, Amelia B. Edwards, Disraeli, R. D. Blackmore and Percy Greg glorified the Confederacy and reflected the partisanship of the fashionable world for the South, both during the War, and in some quarters for fifteen years afterwards. But the abolition of slavery, the amnesty granted the South and the speedy recovery of the Union gained America a new respect among the majority of Englishmen, and in the 70's, novelists of a liberal temper, George Meredith, Charles Reade, Justin McCarthy and others, reflect a strong confidence in America's future. Chapter Six is devoted to Anthony Trollope's American novels, which contain the most impressive and varied American portraits of the century. His "Big Money" novel, The Way We Live Now, contains two dispassionate and perceptive portraits of American invaders of Britain, and in The American Senator he used an attractive, almost heroic American to anatomize the human waste and injustice of class-bound British society.

Chapter Seven gathers together a group of minor novelists of the 60's, 70's and 80's who made special use of American material or who had unique American experiences. Captain Mayne Reid's novels conducted a Wild West show for British boys of three generations. Charlotte Yonge's family novels displayed to a wide audience her half-fascinated, half-alarmed reactions to the mores of the American family. Louis J. Jennings told the fabulous story of Jay Gould in The Millionaire. The novels and stories of Laurence Oliphant analyzed the social morality of Main Street and Fifth Avenue and compared the American scenes to their English equivalents. The study ends with the sentimental American fiction of Walter Besant, and with Hamilton Aide's return to Mrs. Trollope's formula in A Voyage of Discovery, A Novel of American Society.

397 pages. $4.96. MicA 55-1107

LITERATURE AND MORALITY IN PIERRE NICOLE

(Publication No. 11,031)

Edward MacGregor Stack, Ph.D.
Princeton University, 1950

Although the principal purpose of literature is aesthetic, aimed at pleasing and entertaining the reader, the social and religious conventions of the Classical period of French literature required that works have moral utility as well. The preoccupation of authors with justifying their writings on moral grounds is manifest in their prefaces. Among the factors which contributed to impose the requirement of "utility" upon authors were various representatives of the Church, the directors of conscience and guardians of morals. Some clerics such as Huet or the Jesuits were rather liberal in their interpretation, leaving the authors comparatively free; others, such

as the Oratoire and Port-Royal, imposed extremely strict standards. Nicole, as a former teacher of literature and spokesman for Port-Royal doctrine, represents an extreme view on the moral utility of literature.

Nicole divided literature into two classes: useful and harmful. The distinction is based not upon aesthetics, but upon the effect a work has upon the morality of the reader. If the effect is to obtain faith in Christian dogma, and to revise the reader's way of life in the direction of asceticism, austerity, and complete abnegation of all material pleasures – including emotions – the work is utile. All other works are at best useless (inutile), and usually harmful, in that they unnecessarily arouse the innate corrupt tendencies of man, and draw him towards vice, sin, materialism, heresy, Epicureanism, and the like. Thus for Nicole all literature is a strong persuasive force, either for God or for the Demon. With the immortal soul of the reader at stake, it is unsafe to allow him to read any but useful works; these include the Bible, works of the Saints, and theological treatises. Fiction is entirely condemned, for it is necessarily concerned with the presentation of vice, rendered agreeable and palatable; the mere sight of passion is sufficient to induce vice in the reader, regardless of the "tardy remedies" of the authors in punishing vice and rewarding virtue in the conclusions and prefaces. Everything which is read or seen sinks into the subconscious mind, and will eventually manifest itself in thoughts – which lead to actions. If these thoughts be vicious, the actions resulting will be vicious; sin consigns the soul to perdition. Since Nicole's scheme for utility excludes the true subjects for fiction – human passions, vices, and conflicts – the attempts of authors such as Racine to conform met with failure.

Nicole was interested in the matter of literary style: clarity, simplicity, variety of expression, conciseness, and logical progression of ideas were elements he sought. He looked to the Ancients for models of this kind of style. In all of this he is thoroughly classical. He applied his criteria to the Bible, which he thought was too complicated and full of equivocations; and to Pascal, whose Pensées lacked coherence. Yet in every case in which he invoked stylistic criticism, his sole purpose was to improve the moral persuasiveness of the work involved. His fundamental criterion is continually Truth (-Christian, austere, dogma) and utility – forcefulness of moral persuasion.

The fanaticism of Nicole's condemnation of fiction was reinforced by the vigour of Bossuet's denunciation of the theater. The influence of such clerical authorities as these, and the social concept of the "honnête hemme" under which the individual to the accepted standards – including religious – caused literary artists to attempt to justify their works on the basis of their moral instruction. With the advent of the Age of Reason and its accompanying movement towards amorality, atheism, and independent thinking on religion, writers freed themselves from the tyranny of morality, and from the necessity of utility. Pure aesthetics, and "Art for Art's Sake" of later times are the heritage of this emancipation of art.

Port-Royal, represented by Nicole, evolved and practiced the simple, clear, concise, logical style of French which replaced flowery préciosité. Such a style was admired and used by subsequent generations; yet if the style of Port-Royal endured, it is ironical that the purpose for which it was formulated – moral utility and persuasion – was divorced from it. Although Port-Royal had advocated a universal reform of subject-matter and treatment in literature for the purpose of Christian propaganda, their real contribution to literary art was stylistic. Nicole proved that complete moral utility and literary aesthetics are incompatible from the point of view of art; for human foibles are the material with which the creator of literary art must work.

198 pages. $2.48. MicA 55-1108

THE SIGNIFICANCE OF THE LITERARY CAREER OF THOMAS NASHE

(Publication No. 11,436)

Walter F. Staton, Jr., Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. Matthias Shaaber

This dissertation attempts to discover the meaning that Nashe's various works had for his contemporaries as well as the purpose that he had in writing and publishing them.

Four separate lines of inquiry are directed toward this end. First, the facts of the Elizabethan book trade and of Nashe's biography are examined to reveal what in the way of fame and profit Nashe expected and got from his writing. Second, Nashe's education and reading are examined and compared with the education and reading of his contemporaries to make possible an assessment of his intellectual status. Third, Nashe's remarks on literary structure and style are compared with the ideas of his contemporaries on these subjects and with his own practice in an effort to construct a realistic account of his theory of literature. Last, his opinions on manners and morals are adumbrated to gain some insight into the sort of literary meanings that might reasonably be expected from him.

In the light of these findings, Nashe's individual works, particularly Pierce Penilesse, Summers Last Will and Testament, The Unfortunate Traveller, and Have With You to Saffron-Walden, are interpreted.

It is concluded that Nashe regarded himself and was regarded by his fellows as a sort of virtuoso rhetorician, that he wrote primarily for applause, that his writings are hortatory rather than intellectual, but that in the Elizabethan age such qualities and aims did not prevent him from commanding the esteem of the cultured. 198 pages. $2.48. MicA 55-1109

THE RESURRECTION OF THE PURITAN: A STUDY OF AN AMERICAN LITERARY SYMBOL

(Publication No. 11,441)

James Robert Vitelli, Ph.D.
University of Pennsylvania, 1955

Supervisor: Robert E. Spiller

During the first three decades of the twentieth century, many American writers, seeking to understand, to explain, and finally to recreate the American experience, expressed their efforts with a symbol: the Puritan. This dissertation is an account of how a collective symbol of the Puritan appeared, took shape, and was put to use; how it served to develop an American criticism; how it created an articulate consciousness about America and American literature.

The dissertation aims at a synthesis of the contributions of individual writers to the making of the symbol, rather than at an analysis of it. The question of how accurately the symbol of the Puritan reflected the American experience that provoked it has been subordinated to a demonstration that the image of the Puritan is a kind of empirical fact itself, having a discernible effect upon the history of the American mind.

Though the image of the Puritan loomed large in the popular imagination, it was largely the creature of certain critics of American life and thought whose values were literary, who knew the image-making power of language and how to use it. The years 1908-1925 roughly mark the period when the issues of the literary debate over the Puritan were defined, contended over, and partially resolved. In 1908 Van Wyck Brooks, who became the leader of those critics who saw the Puritan casting his thin shadow over the blighted cultural landscape, published The Wine of the Puritans, championing a new romanticism. In the same year Irving Babbitt, waving the banner of classicism and traditional values, published his first book, Literature and the American College. By 1925 with the appearance of Brooks's The Pilgrimage of Henry James, the symbolic Puritan reached his full stature; by this time too, Babbitt and those who followed his leadership had defined their position and opposition. The image of the Puritan stalked across the American imagination in these years; the Puritan and Puritanism became issues in themselves, as symbols. Neither before nor after this period did they possess the same intense capacity for arousing controversy.

The method has been to trace the evolution of an anti-Puritan bias in the writings of several major critics – Van Wyck Brooks, Randolph Bourne, George Santayana, H. L. Mencken, Joel E. Spingarn – observing how similar ideas recurred, how words became jargon, how familiar images clustered around the central image of the Puritan. The same has been done with the work of Irving Babbitt, Paul Elmer More, W. C. Brownell, and Stuart P. Sherman, tracing how in the reaction of each group of critics to the other there resulted a fusing of intellectual and emotional attitudes which broadened and enriched the symbol of the Puritan.

573 pages. $7.16. MicA 55-1110

THE WHITE DEVIL, AN HISTORICAL AND CRITICAL STUDY

(Publication No. 11,051)

Frank Whittemore Wadsworth, Ph.D.
Princeton University, 1951

John Webster's tragedy, The White Devil, has been misunderstood by both critics and scholars. Among the most damaging misconceptions are those arising from the attempts of scholars such as E. E. Stoll and F. T. Bowers to force The White Devil into one of the misleading categories used to classify late sixteenth and early seventeenth century tragedies of blood. Thus Stoll calls The White Devil a Kydian revenge play and Bowers a Marlowesque villain play and each misinterprets the tragedy to make it conform. While the attempt to force a play into a rigid classification is useless, some order can be created out of the chaos which marks Elizabethan and Jacobean tragedy by distinguishing between certain popular theatrical conventions and by analyzing the manner in which contemporary dramatists utilized them. A brief analysis of The White Devil shows that Webster has used several of these conventions and suggests the necessity of understanding his handling of them. The failure of the play's historical sources to indicate anything of Webster's dramatic intent is noted and it is proposed to examine The White Devil in the light of other plays of the period utilizing the conventions of the courtesan, of the lustful woman, of the villain, and of revenge-for-blood.

The first group of plays to be examined are those which make use of the convention of the courtesan. A comparison of Webster's handling of Vittoria with the treatment of admitted prostitutes in other plays of the period, shows that Webster in no way considered Vittoria as a professional prostitute. It is shown that she is never labelled as such in any dramatic context which would lead us to believe the accusation, and this treatment is contrasted to the obvious manner in which the dramatist makes his courtesan's occupation clear in such plays as The Dutch Courtesan and The Honest Whore and the contemporary tragedies which have courtesans as characters. It is also shown that the terms used to describe Vittoria, while implying a prostitute to modern ears, were commonly used in Webster's day in the more general sense of a lascivious woman and that the more specific terms for a prostitute are never used in connection with Vittoria. In addition, it is shown on bibliographical grounds that the title-page statement that Vittoria was the "famous Venetian Curtizan" has little claim to being the author's title.

In spite of the Elizabethan willingness to believe in the actuality of evil, there are not as many unmotivated villains in the contemporary drama as is

commonly assumed; they tend rather to be weakly motivated. A villain is defined as one who is interested in the crime itself rather than in the object of the crime. It is then shown that Vittoria has nothing in common with the conventional villainess, who is customarily motivated by simple physical desire, by greed, or by some aberration or combination of one of these motives. A comparison of The White Devil with those plays in which female characters are motivated by gain makes it clear that Webster did not consider Vittoria as a greedy or ambitious woman, while a study of those plays in which women are driven into crime by animal lust makes it clear that Webster did not conceive of her as this type of person. It is shown that Vittoria's love is a sincere affection of a spiritual as well as a physical nature, and that the treatment of her recalls that of the heroine in such plays as Daniel's Cleopatra and Shakespeare's Antony and Cleopatra, rather than in those of the type of Lust's Dominion and The Turk.

Brachiano has no more in common with the conventional stage villain than does Vittoria with the conventional villainess. Not only is his love for Vittoria depicted in a manner quite unlike the conventional lust-driven villain, but he performs his wickedness with a matter-of-fact air that is a far cry from the self-conscious villainy of the traditional stage villain. Brachiano, like Shakespeare's Claudius and Macbeth, is not a conventional villain, but a successful attempt to present evil in convincingly human terms. Flamineo, on the other hand, is a synthesis of all the important characteristics of the traditional tool-villain; his evilness, his willingness to perform another's wickedness, his greed, his wit and his brashness all being conventional characteristics. Only his courage in the face of death is unusual, and Webster may have found the idea for this in Tourneur's Borrachio.

As a result of the investigation of Vittoria and Brachiano in relation to the villains and villainesses of the contemporary drama, it can be said that Webster's intent was to create a story of powerful if illicit love much in the fashion of Shakespeare in Antony and Cleopatra. A similar study of the counter action of the revengers in relation to the convention of revenge-for-blood, shows that Webster's treatment of the revenge action is designed to emphasize the story of the two lovers and to keep it in its proper moral focus. The revenge-for-blood tradition is sketched briefly, from its beginning at the hands of Kyd and Shakespeare, through its subsequent development in two distinct directions, one approving of the revenger and his revenge, and the other disapproving of either the revenger or the idea of revenge itself. It is shown that Webster has taken something from each type, for he has emphasized the justification of the revengers' actions, but has indicated disapproval of the manner in which they carry out their revenge. The result of his treatment of the revenge-for-blood theme is to clarify the moral position of Brachiano and Vittoria, for the revengers' acceptance of revenge as a sacred duty emphasizes the fundamental guilt of the lovers. At the same time the Italianate features of the revengers' actions tend to reserve audience sympathy for Brachiano and Vittoria in spite of their crimes. The first part of the investigation concludes, then, that Webster visualized The White Devil primarily as a study of the effect of a powerful but illicit passion upon a man and woman of great courage and fortitude who were nevertheless inherently and fundamentally evil.

Part II is a study of the stagecraft of The White Devil in the light of Webster's intent, as ascertained in Part I. The action of the play is analyzed at considerable length and it is shown that Webster is a dramatist of far greater skill than has usually been recognized. While there is an occasional striving for effect, the charge of sensationalism is not provable and Webster's stagecraft is on the whole sound and frequently brilliant.

A study of Webster's characters indicates that while they do not show the spiritual development that Shakespeare has led us to expect, they are none the less consistently and effectively portrayed. The theatrical effectiveness of some of the minor characters is shown, and several important characters who are customarily ignored by the critics are reexamined. A particular effort is made to revive the theatrical reputations of Brachiano, Isabella, Francisco and Lodovico. The relationship of Brachiano and Vittoria is further analyzed and additional confirmation for the view of The White Devil which this study sets forth is found.

The investigation concludes with a short study of Webster's imagery and the important place it holds in his dramaturgy. It is shown statistically that the imagery is very frequent and is largely responsible for the atmosphere of unusual gloom and evil that marks The White Devil. The method by which Webster uses imagery to take the place of the soliloquy as a means of revealing character is analyzed. The investigation ends by showing that not all Webster's imagery is grotesque and disgusting, but that it is capable of moments of great poetic beauty. Webster's finest poetry is used to reveal the weariness with life and the resignation towards death that typifies the philosophy of The White Devil.

416 pages. $5.20. MicA 55-1111

A SEVENTEENTH CENTURY CONCEPT OF THE INDIVIDUAL AND SOCIETY: GUEZ DE BALZAC

(Publication No. 11,061)

John Francis Winter, Ph.D.
Princeton University, 1950

The seventeenth century ranged Balzac among the outstanding authors of his time, and historical criticism has so far not explained the enthusiasm which this author aroused in his own period. We have lost sight of his vitality. Today he is considered by most as a writer of secondary importance, his outstanding merit being the creation of a new French prose.

Our failure to visualize Balzac's message to his contemporaries may have to do with the fact that we

divorce style from thought and that we have not studied the author's intrinsic intentions. The present dissertation represents an effort to examine Balzac's text from within, as an organic unity, considering forms of style as particular features of thought.

Such an inquiry reveals Balzac laboring on one of the great and exciting problems of the period: the adjustment of the individual to society. While struggling with this theme Balzac develops an interesting pattern of thinking. The individual and society appear as distinct and opposite realities. The author either blends them or he presents them as contradictory and conflicting phenomena.

The problem presents itself under different aspects in the three chapters of the inquiry. The first one, a biographical sketch, shows the individual Balzac struggling with society in life. Although he endeavors to adjust himself, he is too bookish and independent to succeed completely or with ease. The conflict between these contradictory forces goes through every phase of the author's career. A youthful plan for a diplomatic position fails for lack of a sustained effort and proper disposition. Half-hearted attempts for a position at court go the same way and lead eventually to failure. All his life Balzac remains at the edge of society, considered a distinguished outsider in Paris, with a taste for solitude, nature and learning. And till the end of his days he will be torn between the desire for independence and the aspiration to be a member of the Parisian elite.

The theme then is studied in its ideological aspects as expressed in the Prince, in Aristippe, in the Socrate Chrestien, in Barbon, in the Discourses and the letters of Balzac.

Chapter II deals with the relationship between eternal and temporal realities, a topic Balzac pursues with great passion and determination. Although masterfully blended in the composition of the Prince, these two poles of the problem appear as distinct and conflicting phenomena in the introduction of this treatise, as well as in the Socrate Chretien and numerous passages in Balzac's discourses and letters.

Chapter III based on the main body of the Prince and on Aristippe, deals with Balzac's moral theories. In this particular field the subject presents itself as an investigation of the relationship between inner life and the outside world. Balzac is seen as departing from the individualism of late sixteenth century moralists, from Montaigne and the neo-stoics Lipsius, Du Vair and Charron. He labors on a double-standard of morality, destined to satisfy simultaneously the obligations of a perfect inner life and the dictates of society. Action is the bridge between the two criteria, and therefore the sole valid manifestation of excellence. In a prodigious effort to satisfy both, the author develops his concepts of virtue: those of piety, chastity, learning, courage, judgment, patience, and probity. The same principle assumes a very interesting shape in the realm of vice. Since virtue consists in man's perfect acquittal of these two obligations, vice will be seen in the adherence to only one and the neglect of the other. Accordingly we find two species of vice in Balzac. Both appear as pretences to virtue, as pseudo-virtues with a false glitter of excellence, because they answer to only one of the requirements. In the one case, when man follows a purely individualistic notion of excellence, he will live in a world of fancy and be in steady conflict with the outside world. This is false virtue. It derives from some defect in the psyche. Then we have deceitful virtue, a more condemnable vice, because it involves evil intentions. Here inner depravity hides behind the outer forms of virtue, to pursue its wicked objectives, to delude and defraud the world.

We can observe in Balzac a disintegration of formerly homogeneous realities, and a conscious effort to blend them while realizing their contradictory qualities. This may be considered an aspect of baroque mentality. As such it adds interest to parallels drawn in our concluding chapter between this author and a number of outstanding classicists. They also show that Balzac must be considered a thinker of importance. His ideas explain essential characteristics of the seventeenth century theater. They contain vital elements of the Cornelian concept of virtue. His theory on vices is of particular importance. It shows in their genesis, basic themes developped in the writings of Corneille, Pascal, La Rouchefoucauld, Racine and above all Molière. Most main characters of Molière's comedies can be traced to fundamental principles elaborated by Balzac.

137 pages. $1.71. MicA 55-1112

THE REPUTATION OF SAMUEL TAYLOR COLERIDGE AMONG HIS CONTEMPORARIES IN ENGLAND

(Publication No. 11,063)

Lawrence Wynn, Ph.D.
Princeton University, 1951

This study traces the evolution of Coleridge's reputation as poet, talker-lecturer-critic, and political theorist-philosopher-theologian; indicates relationships among his standings in these fields; and interprets, wherever possible, individual estimates in terms of taste, bias, or principle. Contemporary documents reveal that Coleridge acquired not a single reputation but mutually influential reputations and that Coleridge the personality was a pervasive force in their development.

Throughout his career Coleridge's serious concern for his reputation and dissatisfaction with contemporary criticism, particularly with its partisanship and personal malignancy, led him to joust continually with his critics. In a period when reviewing was much concerned with personality, no one could be neutral toward Coleridge. Almost invariably the man was weighed with his works. With remarkable powers as well as many human frailties, he won advocates easily and as readily acquired inveterate foes. Time dulled differences, and the greatness of the man emerged with the worth of his work. Analysis of his career demonstrates that the reputation of Coleridge the personality was inextricably involved in the reception of his art and thought.

As a young poet, Coleridge was praised for promising originality, but he was soon labeled a Lakist innovator and scourged for nonconformity. Despite his poetic silence after 1803, the Reviews continued to notice him, to misunderstand his purposes, and to use his poems as a platform for polemics. With the 1816 "Christabel" volume Coleridge's poetic reputation reached its nadir; virulent abuse in the press, its peak. Favorable re-evaluations of the "mystery poems" in 1819 stimulated general re-examination of his poetry, which assured his fame. With few exceptions, references to the poet were increasingly favorable until his death. Commendations, intensified in 1834-1835, continued undiminished through 1840.

Whereas the poet's standing fluctuated radically, Coleridge's reputation as talker-lecturer-critic grew steadily. He soon became widely known for brilliance and fluency of discourse and breadth of learning, a celebrity undimmed by years of despair (1800-1807). Lectures on literature and philosophy (1808-1819) confirmed opinions of his charm in delivery, perspicacity in critical insight, and range of reading and reflection, but convinced some auditors of his propensity for abstruse digressions and his inability to conform to conventional order. Meanwhile the Biographia Literaria earned him additional credit as a critic. At the Gillmans, Coleridge attracted ever-increasing audiences, of whom many became press agents for him. Not all who heard him admired him, but the predominant view after 1820 was the wish that Coleridge might talk on forever. Posthumous publication of Table Talk and Literary Remains established Coleridge even more firmly as the most impressive talker and critic of his age.

Coleridge quickly earned reputation for radicalism and heterodoxy in politics and theology, but only his intimates knew of his early philosophical studies. His increasing conservatism and orthodoxy soon provoked attacks for renegadism and apostasy, abuse which gathered impetus from his Courier associations. The 1809-1810 Friend stamped Coleridge as an undecipherable writer upon abstruse political-philosophical-theological matters, a view confirmed by the Lay Sermons, the Biographia Literaria, and the revised Friend. In the 1820's his few steadfast defenders received reinforcement from the growing band of disciples who secured broader reception for his ideas. Aids to Reflection (1825) and Church and State (1830) convinced many readers of the significance of his thought. By 1834 the political theorist was admired but not unassailed; the philosopher-theologian was virtually without peer. The next six years brought him general acclaim as one of the major seminal forces of his times.

A comprehensive survey of Coleridge's reputation reveals correlations in the evolution of his standing as poet, talker-lecturer-critic, and political theorist-philosopher-theologian, but demonstrates that fluctuations in the public's esteem for his various contributions were not consistently parallel until after 1825. Ever an opponent of "acts of uniformity," Coleridge had to await and partially to create developments in taste and critical principle before receiving adequate evaluation. Forced to familiarize his audience with his materials, his manner, and his method, and, paradoxically, to compete with the extravagant expectations of his contemporaries, Coleridge eventually won rank among the greatest artists and thinkers of his day, a position virtually unchallenged in 1840.

568 pages. $7.10. MicA 55-1113

LIBRARY SCIENCE

THE INFLUENCE OF SCHOLARS ON RESEARCH LIBRARY DEVELOPMENT AT THE UNIVERSITY OF ILLINOIS

(Publication No. 11,551)

Wayne Stewart Yenawine, Ph.D.
University of Illinois, 1955

Between 1900 and 1930, the University of Illinois Library moved from an inconspicuous place among American university libraries to a position of national importance among research libraries. The significant and rapid development of this Library is the subject of the study, particularly the relationship of scholars to the origin or research library objectives and the scholars' influence on the growth of research collections and services. Two lines of investigation were pursued: first, an investigation of the structure of scholarship at the University between 1900 and 1930; and second, an investigation of library development during the same period.

President Edmund J. James, shortly after his appointment in 1904, redefined the functions of the University, elevating research to a level of importance equal to that of teaching. Resources were concentrated upon the research program, and in expanding scholarly activities at the University, James increased the number of scholars, placed heavy responsibilities upon them, and bent every effort to meet their requirements. The scholars insisted that one of their most urgent needs was a research library. By their membership in the Senate Library Committee and the executive faculty of the Graduate School, they controlled the long-range planning and acquisition policy of the Library. The Graduate School, reorganized and expanded in 1906, gave a strong impetus to research library development.

Library leadership was an important contributing factor in research library development. During the ten years between 1897 and 1907, Miss Katharine L. Sharp built a dynamic library which was well adjusted to the general instructional program of the University.

Phineas L. Windsor, selected to succeed Miss Sharp and to direct the development of library service to scholars, strengthened the library organization and integrated library functions with the research and graduate programs.

Adequate financial support was a second important contributing factor in research library development. University officials assumed the responsibility of obtaining the necessary funds and when all their efforts to obtain larger direct legislative appropriations for the Library failed, financial support was increased substantially by using departmental equipment funds. Within the University's budget limitations, financial support for the Library reflected the total library needs of the University. The fiscal policy embraced research library objectives without compromising general library improvement, growth of the staff, and new buildings.

Research library development was a direct response to the needs of the University's scholars and was an integral part of the institution's growth as a research center. Scholars, as the focus of administrative attention, formulated research library objectives and controlled resource development. Changes in the character and size of the University Library took place rapidly under the interacting influences of scholarly leadership and adequate financial support.

294 pages. $3.68. MicA 55-1114

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NON-OSCILLATION AND DISCONJUGACY IN THE COMPLEX DOMAIN

(Publication No. 11,553)

Paul Richard Beesack, Ph.D.
Washington University, 1955

Chairman: Zeev Nehari

This paper deals with the zeros of solutions of the second-order, linear differential equation

$$w'' + p(z)w = 0, \tag{1}$$

where $p(z)$ is a function analytic in a region R of the complex plane. Equation (1) is said to be non-oscillatory in R if none of its solutions vanishes more than a finite number of times in R. It is disconjugate in R if no solution vanishes more than once in R. Brief mention is made in the introduction and at other appropriate places of the close relationship of these concepts to the theory of univalent (or more generally, n-valent) analytic functions.

If a particular solution $w(z)$ of (1) vanishes at a point $z = a$, and does not vanish again in a region R containing the point $z = a$, then R is called a zero-free region. On the basis of a comparison theorem in section 1.3 we indicate how such zero-free regions may be constructed. This comparison theorem, together with its corollaries, is also fundamental for much of the rest of the paper. Using a theorem of E. Hille on zero-free regions, we deduce several non-oscillation theorems in section 1.4. In section 1.5 we obtain circular zero-free regions based on criteria quite different from those of Hille. This section also provides the basis for the non-oscillation theorems of section 1.6. The theorems of this section are extended in several steps from non-oscillation in a strip to non-oscillation in any sector smaller than a half-plane. In the following section conditions are given which insure that no solution of (1) has more than 3 zeros in a half-plane. This is accomplished by the construction of a very extensive zero-free regions. The theorem of section 1.8 gives a sufficient condition for the disconjugacy of (1) in circular regions; here again, the ideas of section 1.5 are prominent. By applying a special case of an integral inequality (proved in section 1.1) and constructing rather extensive zero-free regions, we obtain conditions which guarantee the non-oscillation of (1) in a neighborhood of a singular point of the equation. This result is a partial extension of the well-known results in the real case for the equation

$$y'' + p(x)y = 0, \qquad (p(x) \leq a/x^2).$$

Chapter II is more homogeneous in nature — both in the results and in the techniques employed. One of the main results of Chapter II is the theorem of section 2.2 establishing a lower bound for the distance between any pair of zeros of any solution of (1) in a circle $|z| < R$. The result is typical of most of the theorems in Chapter II in that a problem concerning a complex differential equation is reduced to an examination of a real differential equation involving a parameter. The remainder of section 2.2 and section 2.3 is devoted to corollaries and examples of this theorem, including several sharp cases for disconjugacy. It is shown that the theorem includes some results which were announced (without proof) by V. V. Pokornyi in 1951. (In section 2.1 we supply the proofs of several lemmas on real differential equations stated by Pokornyi; these lemmas prove useful in showing the relationship between the results of sections 2.2 and 2.3.) The two theorems of section 2.4 give criteria which guarantee the disconjugacy of (1) in $|z| < 1$ provided a related real differential equation (involving a parameter) is disconjugate on an appropriate interval of the real axis, for specified parameter values. 92 pages. $1.15. MicA 55-1115

CERTAIN EFFECTS OF THE NON-EUCLIDEAN GEOMETRIES ON THE THEORY OF KNOWLEDGE

(Publication No. 10,623)

Azelle Brown, Ph.D.
New York University, 1954

This dissertation aims to trace certain effects which the development of the non-Euclidean geometries had upon the Kantian synthetic à priori and upon the nature of scientific knowledge.

It is contended that the contemporary view, that the axioms of geometry are implicit definitions, that is, are statements of relations between undefined terms, totally devoid of any necessary connection with the physical world, led to the dissolution of Kant's original problem. Kant's conception that the axioms of geometry were synthetic à priori judgments arose from the need to explain how it could be that universal and necessary statements were validly applicable to empirical facts. The non-Euclidean geometries, giving rise to the modern axiomatic view, resulted in the recognition of the facts that the axioms are neither universal and necessary truths, nor are they generalizations from experience, and that geometry need not be applicable to observable fact, though it may be made so by associating the undefined terms with physical bodies. With the evolution of these ideas, it became meaningless to ask how universal and necessary truths could be validly applied to empirical fact and the Kantian problem, in turn, appeared unwarranted.

The existence of a plurality of geometries, each one as logically consistent as the other, also led to

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the realization that geometry had a dual nature. On the one hand, it was a pure study of relationships between symbols having no connection whatsoever with the empirical world; on the other hand, when natural phenomena were associated with the undefined terms in the axioms, it was an applied study, yielding information about the physical world.

This new aspect of scientific knowledge, namely, the dual nature of geometry, was accompanied by another. The non-Euclidean geometries, by their very existence, demonstrated that mathematics was not a body of universal and certain knowledge. This meant that science lost the model after which it had for centuries sought to pattern itself. The resultant investigation into its own nature terminated in the view that scientific knowledge is not a single, absolute, theoretical system which serves as an explanation of observational data, but is rather a body of tentative knowledge, always subject to future change, and that scientific method consists in the interaction of both rational and empirical procedures.

Furthermore, the part that mathematics plays in scientific methodology emerged in a markedly clarified role. No longer does it function as a pattern of certitude, nor is it a body of à priori knowledge which by some mysterious process is deemed applicable to observable facts. Rather, it is a rational construction specifically framed to describe the behavior of past observations and to enable the prediction of future ones and, thereby, has as a major function the significant direction of inquiry. The scientific hypotheses, in spite of their mathematical formulation, are no more than tentative. If the logical derivations, which result from the mathematical formulations, yield results which are not in accord with empirical observations of the present or the future, then it is the mathematical hypotheses themselves that are abandoned or corrected. This procedure represents a radical transformation from all those which preceded it, wherein science either consisted of generalizations from experience, or else of systems imbued with qualities of absoluteness and universality.

It thus becomes clear that the non-Euclidean geometries profoundly affected the existent epistemological theories and served to uproot some traditional conceptions concerning the nature of scientific knowledge and method. 76 pages. $1.00. Mic 55-112

ON PARTITION SYSTEMS, CHORDAL SYSTEMS AND THEIR APPLICATION TO REGULAR CURVE-FAMILIES FILLING THE PLANE

(Publication No. 11,263)

Earl Hicks Crisler, Ph.D.
University of Michigan, 1955

The purpose of this paper is to investigate chordal systems and a weaker system called a partition system. The paper consists of four chapters. The first serves as an introduction. It discusses the relationship of chordal systems to regular curve-families filling the oriented plane and gives some geometric background for the work to follow. In addition, some results of W. Kaplan's investigations on regular curve-families are presented without proof.

The second chapter deals with partition systems. Two sets of axioms for partition systems are given and their equivalence demonstrated.

In the third chapter, an intrinsic topology is introduced for partition systems. In terms of the intrinsic topology, a necessary and sufficient condition is determined, so that, if a partition system satisfies this condition, then it is normal, that is, it had a particularly simple structure consisting of a denumerable number of half-open intervals.

In the last chapter, the notion of discontinuity element is introduced. The various types of discontinuity elements that a partition system and chordal system may have are classified. The main theorem of the chapter shows that a necessary and sufficient condition for a normal chordal system to be isomorphic to the chordal system defined by the level curves of the real part of a schlicht function in $|z| < 1$ is that it contains no Y-discontinuities.

72 pages. $1.00. MicA 55-1116

ALMOST-CONTINUOUS MAPPINGS OF HAUSDORFF SPACES

(Publication No. 11,585)

Richard Dilworth Edwards, Ph.D.
University of Pittsburgh, 1955

"A mapping $T(S) \subset S^*$ is almost-continuous at a point $x \epsilon S$ if and only if for every open set $G^* \subset S^*$, containing $T(x) = x^*$, there exists an open set $G \subset S$, containing x, such that $T(G) \cdot \zeta(G^*)$ is at most a denumerable set."

Almost-continuous mappings are a class which includes the continuous mappings. Hence they do not have all the properties of the more restricted, well-known, class of continuous mappings.

To help describe the properties of A-continuous mappings, some new types of point sets are defined: almost-open, almost-closed, almost-compact, and strongly connected. An A-open set, for example is defined as follows: "A set $E \subset S$ is termed A-open if and only if for every point $x \epsilon E$, there exists an open set $G \subset S$, containing x, such that $G \cdot \zeta(E)$ is at most denumerable."

Some of the results obtained are:

1. If $T(S) \subset S^*$ is at most denumerable-to-one, T is A-continuous if and only if the inverse of every A-open set is A-open.
2. If S and S^* are metric spaces, with S compact, and $T(S) = S^*$ is an A-continuous, (1-1) mapping, the inverse mapping $T^{-1}(S^*) = S$ is A-continuous.
3. If S and S^* are Euclidean n-spaces, and $T(S) \subset S^*$ is at most denumerable-to-one and A-continuous on S, T is continuous on S.
4. If $T(S) \subset S^*$ is A-continuous on S, and if $E \subset S$ is a compact set, T(E) is A-compact.

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5. If $T(S) \subset S^*$ is A-continuous and at most denumerable-to-one, and $E \subset S$ is a strongly connected set, $T(E)$ is connected.

38 pages. $1.00. MicA 55-1117

ON THE INDECOMPOSABLE REPRESENTATIONS OF ALGEBRAS

(Publication No. 11,299)

James Patrick Jans, Ph.D.
University of Michigan, 1955

The purpose of this investigation is to classify and study algebras over an algebraically closed field according to the number and nature of inequivalent indecomposable representations. It is known from the Wedderburn structure theory for semisimple algebras that such algebras have only a finite number of inequivalent indecomposable representations. Algebras having this property are said to be of finite representation type. On the other hand, there exist examples of algebras with radical which have an infinite number of inequivalent indecomposable representations of a fixed degree for each of an infinite number of degrees. Such algebras are said to be of strongly unbounded representation type. The main results of this investigation are conditions which imply that an algebra is of this latter type.

The assumption of algebraic closure of the underlying field is used to introduce basic algebras. The representation theory of an algebra is then studied by considering representations of its basic algebra. It is established that a representation has an indecomposable direct summand of a certain degree if every element of its commutator algebra has at least that many equal eigenvalues. The lattice of two-sided ideals of the algebra is examined to obtain special elements in the algebra and special two-sided ideals. Representations with these two-sided ideals for kernels are used to construct a representation of degree a multiple of an integer s and depending on a parameter in the field. That a matrix commute with this representation evaluated at the special elements implies that the matrix has at least s equal eigenvalues. The above mentioned criterion implies that the algebra has an indecomposable representation of degree at least s. Direct summands associated with distinct parameter values are then shown to be inequivalent. Algebras for which this construction is possible are of strongly unbounded representation type.

Using the above methods, it is shown that if the two-sided ideal lattice of an algebra is infinite then the algebra is of strongly unbounded representation type. Finiteness of the two-sided ideal lattice is shown to be equivalent to distributivity of that lattice and these properties imply that every two-sided ideal is principal. Finiteness of the two-sided ideal lattice of a basic algebra implies that the algebra is generated by two elements. A commutative algebra with a finite two-sided ideal lattice is shown to be the direct sum of polynomial algebras and hence of finite representation type.

The lattice of two-sided ideals is mapped lattice homomorphically into the lattice of left ideals and the lattice of right ideals. If the image contains a Boolean algebra with more than eight elements, then the algebra is shown to be of strongly unbounded representation type by the methods given above. An oriented graph is associated with each two-sided ideal in the radical, with an edge in the graph for each cover of the ideal. The above methods are used to show that if any such graph has a cycle, a vertex of order four, or a chain which branches at each end, then the algebra is of strongly unbounded representation type.

77 pages. $1.00. MicA 55-1118

THE GEOMETRY OF NON-HOMOGENEOUS LATTICES

(Publication No. 10,954)

Alexander Murray Macbeath, Ph.D.
Princeton University, 1950

The main results of this dissertation are
(i) a generalization to group spaces of Minkowski's Theorem in the geometry of numbers,
(ii) a general theorem about non-homogeneous lattices.

The first part, contained in Chapter I, is a consequence of the observation that the proof of Minkowski's theorem depends, essentially, on only two properties of Euclidean n-space: that it forms a group under vector addition, and that there is a measure which is invariant under translation by the group. Among the proofs of Minkowski's theorem, perhaps that of Hajos (9)[1] is the one that shows this dependence most clearly.

The existence of left-invariant measure in fairly general group spaces was established by Haar (8), and has since been extended to all locally compact groups. Thus the tools for the generalization were already in existence and it was merely necessary to rewrite Hajos's proof suitably.

The statement of the result involves functions which we call norms. A symmetric additive norm for a group G is a real-valued function satisfying the relations

$$N(gg') \leqslant N(g) + N(g'); \qquad N(g) = N(g^{-1}).$$

Then the statement of the generalized Minkowski theorem is as follows. Let G be a topological group whose underlying space is separable, metric and locally compact. Let N be a symmetric additive norm for G. Let Λ be a discrete subgroup of G and let the Haar measure $\triangle(\Lambda)$ of a fundamental domain for Λ be finite; If the Haar measure of the set

$$N(g) \leqslant k$$

is greater than $\triangle(\Lambda)$, then there is an element $\lambda \in \Lambda$, other than the identity, such that

$$N(\lambda) \leqslant 2k.$$

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A special application to 2 by 2 matrices is worked out in detail in chapter 1 and given as Theorem 4.

The remaining three chapters are devoted to the proof and applications of the theorem on non-homogeneous lattices. A non-homogeneous lattice Λ is defined to be a coset of a discrete subgroup of E^n (under vector addition) - where the discrete subgroup has n independent generators. The volume of the fundamental domain of the subgroup from which Λ is derived is called the determinant of Λ, written $d(\Lambda)$.

The geometry of non-homogeneous lattices - concerned with questions of existence of lattice-points in certain regions - began with Minkowski, who proved that, in two dimensions, there is a point of Λ in the set $|xy| \leq \frac{1}{4}d(\Lambda)$ (19). He conjectured the analogous result in n dimensions - that there is a point of Λ in the set $|x_1x_2\ldots x_n| \leq 2^{-n}d(\Lambda)$. This conjecture, which was proved true in three-space by Remak (17) and quite recently in four-space by Dyson (7), was for a long time the only non-homogeneous problem considered. A significant occurrence, from our point of view, in the history of Minkowski's conjecture, was the paper of Tchebotareff (20), in which he proved, for every n, that there is a point of Λ in the set $|x_1x_2\ldots x_n| \leq 2^{-\frac{1}{2}n}d(\Lambda)$. The method of Tchebotareff was modified by Mordell and Davenport to obtain closer approximations to the conjectured constant, and was used by Chalk to prove a related result (15, 6, 4). Other regions, connected with quadratic forms, were considered by Davenport and Blaney (1, 5).

However, it seems to have escaped notice that the method of Tchebotareff is capable of a much wider application. This new application is the subject of the second part of the dissertation. Let R be a convex set in E^n. It is necessary to make the slight restriction that R has n linearly independent tac-planes. Define f(x) in R by the equation

$$f(x) = V(R \cap (2x-R)),$$

where 2x-R is the reflection of R in x and V denotes volume. Then the theorem states that if $\Lambda \cap R \neq \phi$, there is a point of Λ in R such that $f(x) \leq 2^n d(\Lambda)$. It is shown that in some cases the constant 2^n can be improved, but 2^n is the best constant if the theorem is to be true for all R.

The proof depends on the classical theory of convex sets, particularly the Minkowski guage-function, the Brunn-Minkowski Inequality and the compactness theorem of Blaschke. These properties are summarized in Chapter II. Chapter III contain the actual proof of the theorem, and Chapter IV contains a number of particular cases, some of which had previously been treated directly. One of these has an application in algebraic numbers, showing that there cannot be too large a gap between rational integers which are norms of integers in a fixed algebraic number field.

53 pages. $1.00. MicA 55-1119

1. Numbers in parentheses refer to Bibliography of thesis.

CLASSIFICATION OF MAPPINGS OF AN n + 1-DIMENSIONAL SPACE INTO AN n-SPHERE

(Publication No. 10,965)

William Schumacher Massey, Ph.D.
Princeton University, 1949

1. Introduction

The problem of determining all homotopy classes of continuous maps of an (n+1)-dimensional complex K into an n-sphere S^n was solved by Steenrod [13][1]. This solution made use of the fact that the homotopy group $\pi_{n+1}(S^n)$ is cyclic of order two, a result which was proved by both Freudenthal [7] and Pontrjagin [11]. Their proofs are rather complicated.

Without similar knowledge about the structure of $\pi_{n+2}(S^n)$, $\pi_{n+3}(S^n)$, etc., the generalization of the argument to higher dimensional cases is impossible. For this reason it would be desirable to obtain an argument which does not require a knowledge of $\pi_{n+1}(S^n)$. Such a proof is given in this paper. As a corollary, an independent proof of the fact that $\pi_{n+2}(S^n)$ is cyclic of order two for $n \geq 2$ is obtained.

Part I of this paper is devoted to developing the tools used in part II. In part II the Steenrod Extension Theorem is proved; If A is a closed subset of a compact metric space X of dimension $\leq n+2$, and $f:A \to S^n$ is a continuous mapping, this theorem gives necessary and sufficient conditions for the existence of an extension $F:X \to S$ in terms of new operations introduced in sections 8 and 9. The proof is made by an induction on the dimension n; the various steps in the induction are outlined in the first section of part II. This method of proof was suggested by the proof of the Hopf Extension Theorem given by Hurewicz and Wallman, [9]. In part III this extension theorem is applied to obtain various homotopy classification theorems for mappings of an (n+1)-dimensional compact space into an n-sphere. 105 pages. $1.31. MicA 55-1120

1. Numbers in square brackets refer to the bibliography in the thesis.

EXTENSION OF A THEOREM OF HILBERT TO FORMAL POWER SERIES

(Publication No. 11,004)

Félix Recillas Juárez, Ph.D.
Princeton University, 1948

In his classical paper "Uber die Theorie der algebraischen Formen" Hilbert dealt with the following question: Let 1) $F_{t1}X_1 + \ldots + F_{tm}(1)X_{m}(1) = 0$ $(1 \leq t \leq m)$ be a system of equations where F_{ti} and X_i and the left hand sides are forms in n variables.

From Hilbert's basis Theorem it follows that any solution $(F_1, F_2, \ldots, F_{m^{(1)}})$ can be expressed as a linear combination $F_t = \sum_{i=1}^{m} F_{ti}^{(1)} A_i$; $(1 \leq t \leq m^{(1)})$ where the A_i are forms in n variables and the $(F_{1,i}^{(1)}, F_{2,i}^{(1)}, \ldots, F_{m^{(1)}i}^{(1)})$; $(1 \leq i \leq m^{(1)})$ are a certain set of solutions of 1). If we ask for what system of forms A_i are the $F_1, F_2, \ldots, F_{m^{(1)}}$ all equal to zero we obtain a system of equations similar to 1).

Hilbert asserted in his Theorem III that if this passage from one system of equations to another is repeated and if at any chosen step a base of solutions is chosen in a suitable way, a system of equation will be obtained in a finite number of steps which has no solutions and the process will end.

The extension of Hilbert's Theorem III to a system of equations with formal power series as coefficients is made possible by Lasker's extension of the Hilbert basis Theorem to formal power series. It is carried through by constructing the sequence of modules of the solutions of the sequence of equations and by associating to each member of this sequence the module formed from its beginning vectors whose components are forms. Our basis lemma asserts that these latter modules may be obtained from systems of equations with forms as coefficients in the same way as the corresponding module of formal power series was obtained. Thus by an application of Hilbert's Theorem III to the second simpler case of forms we show that the sequence of modules of beginning vectors is finite and by a simple argument the corresponding sequence of modules of formal power series is also finite.

15 pages. $1.00. MicA 55-1121

SEQUENTIAL TESTS OF COMPOSITE HYPOTHESES

(Publication No. 11,657)

Albert Christian Rohloff, Ph.D.
Purdue University, 1955

Major Professor: Henry Teicher

The method of weight functions proposed by Wald[1] is used to construct unbiased two-sided sequential tests for distributions admitting sufficient statistics.

The concept of an optimum weight function as defined by Wald[1] is considered. It is pointed out that the "sufficient conditions" given by Wald under which a weight function is optimum assure only an approximation to the optimum weight function if it exists. Therefore, it is proposed that weight functions satisfying the "sufficient conditions" of Wald be called approximately optimum weight functions. Sequential tests constructed with approximately optimum weight functions are called approximately optimum tests.

The problem of sequentially testing the hypothesis H: $\theta = \theta_0$ where θ is the parameter of a one parameter distribution admitting a sufficient statistic for θ is the first of two problems considered. Here θ_0 is a constant and there are alternatives both greater and less than θ_0. It is shown that for this problem the following two restrictions are sufficient to assure the existence of an approximately optimum test.

i. The first two moments of the sufficient statistic exist and are finite.
ii. There exists a group of order two of transformations of the sample space into itself which induces[2] a group of order two of transformations of the parameter space into itself. The induced group is the group of reflections about the point θ_0.

The first restriction is equivalent to the assumption that two differentiations with respect to θ under the integral sign are allowable. It is shown that for Darmois-Koopman distributions the second restriction is satisfied only when the transformations involved are linear transformations.

Examples for which the above restrictions are satisfied include the normal distribution with known variance and a special case of the binomial distribution. The binomial test is used as the basis of a sequential nonparametric test of the hypothesis that the median of a continuous distribution is equal to some fixed constant.

The Operating Characteristic curves, $\beta(\theta)$, for the proposed tests are monotone increasing for $\theta < \theta_0$ and monotone decreasing for $\theta > \theta_0$.

The second problem studied is the two-population problem. Sequential tests are given for the following hypotheses:

1. Equality of the means of two independent binomial populations.
2. Equality of the means of two independent Poisson populations.
3. Equality of the variances of two independent normal populations with known means.
4. Equality of the variances of two independent normal populations with unknown means.
5. Equality of the scale parameters of two independent Type III populations where all other parameters are known.
6. Equality of the means of k independent normal populations with known variances.

All two-population tests, except for the binomial and Poisson populations, are shown to be approximately optimum tests. It is not known if the proposed binomial and Poisson tests are approximately optimum tests.

Every test which is proposed terminates with probability one. 113 pages. $1.41. MicA 55-1122

1. Wald, Abraham, Sequential Analysis; New York John Wiley & Sons, Inc., 1947.

2. Lehmann, E. L., "Some principles of the theory of testing hypotheses," Ann. of Math. Stat., vol. 21(1950), pp. 1-26.

SOME PROPERTIES OF THE ALEXANDER POLYNOMIAL

(Publication No. 11,045)

Guillermo Torres Diaz, Ph.D.
Princeton University, 1950

In this paper it is proved that the Alexander polynomial $\triangle(t_1, \ldots, t_\mu)$ of a knot K of multiplicity $\mu > 1$ has the properties:

1. There exist integers $n_1, \ldots, n_\mu$ such that,
$$\triangle(t_1, \ldots, t_\mu) = (-1)^\mu t_1^{n_1} \ldots t_\mu^{n_\mu} \triangle\left(\frac{1}{t_1}, \ldots, \frac{1}{t_\mu}\right).$$
2. $\triangle(t, \ldots, 1) = 0$ if $\mu > 2$,
and $|\triangle(1,1)| = |l|$ if $\mu = 2$, where l is the linking number of the two components of K.

Properties 1. and 2. are analogous, in the case $\mu > 1$, of the properties which, in the case $\mu = 1$, suffice to characterize the polynomial. In this paper it is proved that 1. and 2. do not suffice to characterize the polynomial if $\mu > 1$.

61 pages. $1.00. MicA 55-1123

BRANCHED REGULAR CURVE FAMILIES AND FINITE ASYMPTOTIC PATHS OF ANALYTIC FUNCTIONS

(Publication No. 11,373)

David Van Vranken Wend, Ph.D.
University of Michigan, 1955

Boothby, in the American Journal of Mathematics, 1951, has shown that a branched regular curve family filling a simply connected domain is homeomorphic to the family of level curves of the real part of an analytic function. Such an analytic function will be said to be contoured by the given family. It is the main purpose of this dissertation to relate the topological structure of a branched regular curve family filling a simply connected domain and the finite asymptotic paths of the analytic functions contoured by the family.

Suppose f(z) is a function analytic in a simply connected domain D and c: $z=h(t)$, $0 \le t < 1$, is a path in D such that h(t) tends to the boundary of D as t tends to 1. If $\lim_{t \to 1} f(h(t))$ exists and is finite, then the limit is a finite asymptotic value and c is a finite asymptotic path of f(z).

Since only the topological structure of the curve family F is relevant in this dissertation, it is assumed that, after a suitable homeomorphism if necessary, F fills the finite plane. A curve of F is the homeomorphic image of an open interval. The curves of F are of two types: regular curves which tend to infinity in both directions and branched curves which have a branch point as limit point in at least one direction.

If the union k of the curves of a collection of branched curves together with their end points forms a simple curve c which tends to infinity in both directions, then k is an infinite chain. If one of the regions into which c separates the plane contains no branched curve with a limit point on c, then k is called a maximal chain. A regular curve or maximal chain k of F is a b-curve if there exists a regular curve or maximal chain m such that no regular curve or infinite chain separates k and m and no branched curve in the simply connected region bounded by k and m has a limit point on k or m.

Some results proved in this dissertation are the following:

(1) If an analytic function with no finite asymptotic path is contoured by a branched regular curve family F filling a simply connected domain, then F contains no b-curve.

(2) If at most a finite number of branched curves of F intersect any given compact subset of the plane and F contains no b-curve, then there exists an analytic function contoured by F which has no finite asymptotic path.

(3) F contours an harmonic polynomial if and only if F contains no b-curve and at most a finite number of branch points.

After presentation of some basic definitions and theorems in Chapter One, it is proved in Chapter Two that a b-curve contains the homeomorphic image of a finite asymptotic path for any analytic function contoured by F. Hence (1) and the "only if" part of (3) are established. In Chapter Three assumptions on F given in (2) above are made. Then it is possible to define a function contoured by F which has no finite asymptotic path and prove (2) and the "if" part of (3).

102 pages. $1.28. MicA 55-1124

"HEREDITY" THEOREMS ON CERTAIN PRODUCT TRANSFORMATIONS OF THE LINE

(Publication No. 11,611)

John Edward Yarnelle, Ph.D.
University of Pittsburgh, 1955

If a transformation T_1 of a set X to a set Y is followed by a second transformation T_2 of the set Y to a third set Z, the combined effect of T_1 and T_2 may be interpreted as the work of a single transformation, T_{21}, called the product transformation, which conveys X to Z. Certain defining properties of T_1 and T_2 may or may not be "inherited" by T_{21}. In particular, the product of two absolutely continuous (AC) transformations is not always AC and the product of two transformations of bounded variation (BV) is not always BV.

This study develops theorems which deal specifically with the BV, AC, and L (Lipschitz) properties and which delineate specialized conditions under which such properties are transmitted by T_1 and T_2 to T_{21}. Throughout, all transformations are assumed to be continuous and to apply to a single real variable.

The notations $T_1(x)$, $T_2(y)$, and $T_{21}(x)$ refer to the two individual transformations and the product transformation, respectively. The symbol $[T'(x)]^0$ denotes

a function which equals the derivative at points where the latter exists and zero elsewhere. A multiplicity function $N(y, T_1, I_x)$ denotes the cardinality of the set X_y where $x \epsilon X_y$ means $T_1(x) = y$. This function may have infinite values. We denote the Lebesgue measure of a measurable set S by m(S).

The following well-known theorem illustrates the general approach:

(1) Let $T_1(x)$ be AC on I_x. Let $T_2(y)$ be AC on $I_y \supset T_1(I_x)$. Then $T_{21}(x) = T_2[T_1(x)]$ is AC on I_x if either

(i) $T_1(x)$ is monotonic

or (ii) $T_2(y)$ is Lipschitzian.

Examination reveals that (i) and (ii) are not reversible.

Extensions of condition (i) in (1) are possible, such as:

(2) Let $T_1(x)$ be BV on I_x. Let a real number K exist such that $N(y, T_1, I_x) < K$ a.e. on I_y. Let $T_2(y)$ be AC on $I_y \supset T_1(I_x)$. Then $T_{21}(x)$ is BV on I_x.

A "chacterization" theorem is known for AC product transformations in the plane. For a single variable it has the form:

(3) Let $T_1(x)$ be AC on I_x. Let $T_2(y)$ be AC on $I_y \supset T_1(I_x)$.
Then $T_{21}(x)$ is AC on $I_x \leftrightarrow \left\{[T_2'(T_1[x])]^0 \cdot T_1'(x)\right\}$ is summable on I_x.

From this result one deduces the following theorem on the Lipschitz property:

(4) Let $T_1(x)$ be L on I_x. Let $T_2(y)$ be L on $I_y \supset T_1(I_x)$. Then $T_{21}(x)$ is L on I_x.

The characterization for product transformations of bounded variation is:

(5) Let $T_1(x)$ be BV on I_x. Let $T_2(y)$ be BV on $I_y \supset T_1(I_x)$. Then $T_{21}(x)$ is BV on $I_x \longleftrightarrow$ the following two conditions hold simultaneously:

(a) $T_2(\bar{Y})$ has measure zero, where $y \epsilon \bar{Y} \rightarrow N(y, T_1, I_y) = \infty$;

(b) the series $\sum_{i=0}^{\infty} \sum_{j=0}^{\infty} ij \cdot m(Z_{ji})$ converges.

We define the set $Z_{ji} \subset I_z$ in (b) as follows: $z \epsilon Z_{ji} \leftrightarrow$ the set $T_2^{-1}(z) \cap Y_i$ has exactly j elements where Y_i designates the set on I_y such that $y \epsilon Y_i \rightarrow N(y, T_1, I_x) = i$. The i and j are positive integers or zero. $I_z \supset T_2(I_y)$.

If a constant function is used for the first transformation, the product transformation reduces to a constant. When this case is excluded, the following theorem holds:

(6) Let $T_1(x)$ be BV on I_x with $m(T_1[I_x]) > 0$. Let $T_{21}(x)$ be BV on I_x. Then $T_2(y)$ is BV on $T_1(I_x)$.

It is established by additional results that similar phenomena do not apply to the AC and L properties.

47 pages. $1.00. MicA 55-1125

MUSIC

THE CHASSE: HISTORICAL AND ANALYTICAL BIBLIOGRAPHY OF A MUSICAL GENRE

(Publication No. 11,467)

Alexander Lothar Ringer, Ph.D.
Columbia University, 1955

The history of the chasse comprises all descriptive references to the hunt in the music of Western civilization, covering a period of six centuries that extends from the Ars Nova of the early fourteenth to the post - romantic composers of the early twentieth century. As its designation by a French term implies, the chasse genre developed mainly in France or at least under French influence. Both the elaborate ceremonial of the sport and the musical signals which furnished the basic set of symbols employed in the chasse were at all times products of the spectacular hunting activities of the French court. French composers, in keeping with their perennial predilection for the descriptive and the picturesque in music, treated of the hunt in every generation. They were eagerly imitated by foreign colleagues whose own masters often endeavoured to emulate the spirit of Versailles.

The chasse reached three high points in its artistic career, the first halves of the fourteenth and sixteenth centuries, representing the initial stage and the final climax of the vocal genre, and the second half of the eighteenth century, which witnessed the apogee of the instrumental hunting piece. For its musical symbolism the chasse relied at first upon rhythmic devices such as the hocquet, characteristic voice relations as provided by canon and stretto, and, above all, the established repertoire of horn signals and dog calls. With the emergence of opera and autonomous instrumental music the latter were replaced by the more melodic fanfares, which were fully exploited however, only in the pre - revolutionary compositions of the Haydn era. The transition stage is represented in the divertissements, operatic bruits de chasse, and keyboard and violin pieces of the French rococo which left their impact everywhere, including the hunting references in the works of J. S. Bach.

The chasse, more than any other type of topical music, reflected at all times the esthetics of its royal and noble sponsors. Amorous implications are evident especially during the off - periods of the genre, such as the fifteenth and seventeenth centuries. After the French revolution, which destroyed its normal social climate, the genre became generally associated with magic and the supernatural. Beyond its broad socio - psychological and sociological interest the history of the chasse provides specific instances of contrasting attitudes toward program music. The

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three principal compositions of the sixteenth century, for example, reveal the Frenchman Janequin as a coloristic rhythmicist in opposition to Gombert, the Flemish master of contrapuntal devices, while the third, anonymous piece incorporates elements found in both the aforementioned. In the contemporaneous German compositions, on the other hand, realistic description is with a single exception sacrificed to the rigid methods of cantus firmus treatment. The somewhat earlier Italian cacce of the frottola type, finally, are essentially homophonic on contradistinction to the polyphonic transalpine examples.

The present investigation furnishes an analytical appraisal in historical perspective of most known compositions belonging to the genre. In so doing it touches upon a variety of formal problems in music as highlighted by the concentration upon a basically stable topic on the part of musicians of many generations and of greatly diverging artistic tendencies. By implication questions pertaining to classicism versus romanticism, "absolute" versus program music, and other broad issues are illuminated. The appendices provide, in addition to over ninety smaller musical examples, three new transcriptions of chasse compositions of the Renaissance and a preliminary chronological catalogue of the principal musical references. 441 pages. $5.51. Mic 55-113

PHARMACOLOGY

STUDIES ON THE SITE AND MODE OF ACTION OF MERCURIAL DIURETICS

(Publication No. 11,862)

Edward Joseph Cafruny, Ph.D.
Syracuse University, 1955

It is well established that the diuretic effect of mercurial compounds is a result of some action of mercury on kidney tissue. Most of the available evidence indicates that the mechanism of this action involves the inhibition of protein-bound sulfhydryl groups in the kidney.

Experiments were designed to test the theories of sulfhydryl inhibition and to determine the precise location of this inhibition in kidney tissues of the rat.

A qualitative histochemical method for determination of protein-bound sulfhydryl groups (developed by Barrnett and Seligman) was modified and studied in an effort to ascertain whether it could be applied to the quantitative estimation of tissue sulfhydryl concentrations.

The method appeared to satisfy the following major requirements for quantitative cytophotometry:

1. Specificity
2. Adherence to the Beer-Lambert Law
3. Reproducibility

This method was then applied to the study of the effects of an organic mercurial (Mersalyl) on sulfhydryl concentrations in the cytoplasm of various cell types in rat kidney tissue.

Animals were injected with both diuretic doses and nephrotoxic doses of Mersalyl. Kidneys were fixed by perfusion with trichloracetic acid at various intervals following mercurial injections. Groups of animals were injected with Cysteine or BAL in addition to Mersalyl; other groups received only Cysteine or BAL. Control animals were injected with isotonic saline.

The kidney tissues of treated and control animals were prepared by histological sectioning procedures, and stained for protein-bound sulfhydryl groups. Alternate sections were stained for total protein content by the Pollister and Ris modification of the Millon Reaction and by Mazia, Brewer, and Alfert's Brom Phenol Blue method.

A reduction in sulfhydryl concentration was observed in cells of terminal portions of proximal tubules and the brush borders associated with these tubules, in loops of Henle, and in straight collecting ducts in the medulla. No changes were apparent in convoluted segments of proximal tubules or in distal convoluted tubules.

Sulfhydryl inhibition in all affected areas except collecting ducts were seen after 2.5 mg Mersalyl/kg. Effects occurred in the collecting ducts when the dose was increased to 5.0 mg Mersalyl/kg. As the dosage was increased (up to 40 mg Mersalyl/kg), sulfhydryl reduction was more pronounced.

With a diuretic dose of Mersalyl, inhibition in cells of terminal portions of proximal tubules and associated brush borders was maximal at 2-6 hours after injection of Mersalyl. Sulfhydryl concentrations were normal at 24 hours. Progressive inhibition occurred in loops of Henle and collecting ducts, the inhibition being maximal at 48 hours (the last time interval used).

BAL administered before or after Mersalyl restored sulfhydryl concentrations to control levels in all areas. Cysteine was not effective.

No change in total protein concentrations, as measured by the Millon and Brom Phenol Blue methods, were observed.

The data support the theory that mercurial compounds effect diuresis through inhibition of sulfhydryl groups in kidney tissue.

The effects of BAL and Cysteine are consistent with their known physiological actions (BAL interrupts mercurial diuresis; Cysteine does not modify mercurial diuresis).

The differential reactivity of different cell types, which was apparent in the time experiments, may indicate that two distinct mechanisms are involved in mercurial diuresis. It is suggested that these

mechanisms afford (1) volume control and (2) concentration regulation.

The functional segmentation of kidney tubules as revealed in earlier investigations has been reaffirmed with respect to sulfhydryl concentrations in the normal rat. 144 pages. $1.80. MicA 55-1126

THE ANTINEOPLASTIC ACTION OF CITRULLUS COLOCYNTHIS FRACTIONS ON SARCOMA-37

(Publication No. 11,627)

Richard Edward Faust, Ph.D.
Purdue University, 1955

Major Professors: Gustav Cwalina and Egil Ramstad

The plant kingdom offers a vast array of chemical compounds and it is not merely optimistic conjecture to postulate that one or more of these compounds may be useful in the chemotherapeutic attack on cancer. Our study verifies the reported tumor-damaging effect of the alcohol extract of Citrullus Colocynthis on Sarcoma-37 and presents information on our search for the antineoplastic agent in the drug.

Sarcoma-37 was the only neoplasm used in this investigation. In order to transplant the tumor serially, a suitable method for the sterile preparation of tumor inocula was developed. Tumors from donor animals were removed asceptically and ground with isotonic sodium chloride solution in a glass tissue homogenizer. The tumor suspension was inoculated either intramuscularly into the right thigh or subcutaneously into the right axillary region. The tumor was maintained by subcutaneous transplantation into the right axilla of two to four animals every six to ten days.

Drug fractions were administered subcutaneously into the flank contralateral to the thigh tumor. Animals were usually sacrificed 12, 24, 40 or 48 hours after administration of the drug. Comparative histological examinations of treated and control tumors were made in order to evaluate microscopic tumor damage and to ascertain the relationship between gross and microscopic evidence of antineoplastic activity. Since there appeared to be a close relationship between microscopic tumor damage and the gross observation of hemorrhage and necrosis in the sarcoma, evaluation of tumor damage in our studies was based principally on the gross observation of differences between treated and control tumors.

Over 400 Swiss and CAF_1 mice bearing S-37 growing subcutaneously or in the right thigh muscle were used to study the anti-tumor effect of approximately 25 colocynth fractions prepared by solvent fractionation, paper chromatography, column chromatography, and dialysis. One of the outstanding observations of the investigation was that the tumor-damaging capacity of the active colocynth fractions is intimately associated with the toxic principles of the drug. All drug components and fractions that had a toxic effect on the animal also caused hemorrhage and necrosis in the sarcoma, while those that were non-toxic were without deleterious effect on the tumor. Colocynth fractions which possessed tumor-damaging activity caused a reduction in spleen and tumor weight.

Much of the work dealt with the resin of colocynth, which was shown to be highly toxic and highly tumor-damaging, not only to S-37 growing intramuscularly, but also to the tumor growing subcutaneously. Methods for the fractionation and study of the resin by paper chromatography and column chromatography are described. One of two resin components isolated by paper chromatography was active against S-37. Of six fractions obtained by column chromatographic separation on activated alumina and on Florisil, four were toxic and tumor-damaging. By fractionation on a Florisil column two new constituents of colocynth resin have been isolated, one melting at 126° and the other at 152°. Each of these is toxic and tumor-damaging. A concentrated dialysate of the resin produced tumor damage with only moderate accompanying toxicity and was the most promising colocynth fraction tested.

One very potent tumor-damaging fraction of the resin administered in small repeated doses did not prevent the "take" of S-37, but did slightly retard its growth. Repeated doses of the same fraction slightly inhibited the growth of actively-growing S-37.

When the neutral eluate from an MB-1 ion exchange resin column was studied, it was concluded that some of the colocynth constituents which produce tumor damage and toxic symptoms are neutral or high molecular weight principles.

Crude preparations of hentriacontane, alpha-elaterin, and phytosterol, three previously reported non-purgative principles of colocynth, failed to produce tumor damage.

Since the active colocynth fractions consistently caused widespread intestinal hyperemia and severe irritation at the site of drug release, it was felt that perhaps a massive release of histamine was responsible for the tumor damage. Histamine injections produced tumor hemorrhage and necrosis grossly indistinguishable from that produced by the active colocynth fractions. However, pre-treatment of animals with an antihistamine failed to prevent the toxic symptoms and tumor damage produced by two colocynth fractions. 247 pages. $3.09. MicA 55-1127

THE EFFECT OF TOPICALLY APPLIED HYALURONIDASE ON CUTANEOUS PERMEABILITY TO CERTAIN SUBSTANCES

(Publication No. 11,660)

Harold Sheinaus, Ph.D.
Purdue University, 1955

Major Professors: Glen J. Sperandie and
John E. Christian

Percutaneous penetration, permeability, and absorption have been studied extensively, but little has

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

been reported on the effect on penetration of drugs by altering the permeability of the ground substance of the skin through topically applied agents. The objective of this work was to determine the effect of hyaluronidase on the penetration of certain substances applied to the skin in ointment bases.

Four substances were used: S^{35}-labeled sulfanilamide, S^{35}-labeled sodium sulfanilamide, sodium radio-iodide (I^{131}), and radio-sodium (Na^{22}) chloride. Three ointment vehicles were used: an oleaginous base (Plastibase*), an absorption base (Plastibase* Hydrophilic), and a washable emulsion base (Hydrophilic Ointment U.S.P. XIV).

The presence of the enzyme's substrate, hyaluronic acid, in the dermal connective tissue, was first demonstrated by metachromatic staining with toluidine blue.

S^{35}-labeled sulfanilamide and sodium sulfanilamide were synthesized, and chemical and radiochemical purity determined by chromatograph methods in combination with radioactive scanning procedures. Suitable methods for preparing tissue samples for radioactive counting were developed.

The following method was used in the penetration studies: A measured amount of ointment containing a radioactively labeled tracer substance was rubbed into the shaved dorsal skin of a guinea pig by a mechanical device designed to obtain reproducible rubbing. Similar treatment was accorded to a symmetrically located skin area, with an ointment identical in all respects except for the addition of hyaluronidase. After treatment, the animal was sacrificed, skin punches made, and these punches sectioned at 50 microns, parallel to the skin surface, on a freezing microtome. Each section was processed according to a valid method of sample preparation, depending on the isotope used. The samples were then counted for radioactivity, and conclusions drawn based on a study of this data. The criteria used for evaluating penetration were the total radioactivity, and the distribution of this activity in each skin punch.

It was found that the substances studied showed a limited degree of penetration into the skin from the bases used. In the majority of cases, penetration and/or permeability was not appreciably influenced by topically applied hyaluronidase.

Hyaluronidase was found to enhance considerably the penetration of sodium radio-iodide (I^{131}) from Plastibase into guinea pig skin when both were applied together by inunction.

As a result of this work, it can be concluded that topically applied hyaluronidase is able to increase cutaneous permeability to certain topical medication under certain conditions. It is suggested that, although it has shown a high degree of selectivity in producing an effect in these experiments, hyaluronidase may be found useful for specific penetrants not investigated in this work.

97 pages. $1.21. MicA 55-1128

*Plastibase is a trade mark of E. R. Squibb and Sons.

PHILOSOPHY

A PHENOMENOLOGICAL ANALYSIS OF THE STRUCTURE OF THE MORAL SITUATION

(Publication No. 10,981)

David Havens Newhall, Ph.D.
Princeton University, 1948

This essay is a phenomenological analysis of the structure of the moral situation. The central thesis is that moral situations are complex dynamic wholes whose unifying property is a species of requiredness.

Moral situations are identified as situations about which it is theoretically possible to make a true statement saying that something ought to be done. In refining this conception, attention is focused upon the meaning of "ought." Ayer's positivistic analysis of "ought" as non-cognitive is rejected, as are several varieties of the conditional "ought." The moral "ought" is held to be categorical in the Kantian sense.

The moral "ought" refers to a species of the property that Kohler has named requiredness. Requiredness is a gestalt property and thus incapable of existing apart from a context of some sort and incapable of being detected by segmental analysis of the field to which it belongs. It is a member of the special class of gestalt properties which are vectors, and it is unique among vectors in that it demands the object to which it points.

This distinguishes it from the interest vector which indicates an acceptance or rejection of its object but lacks the element of fitness, appropriateness, or rightness that is conferred upon the object of the requiredness vector. Requiredness also differs from causality in that the causal relation makes the effect necessary and leads one to expect its occurrence, whereas requiredness demands what is required without guaranteeing its occurrence and thus leads us to hope for it. Requiredness cannot be identified with possibility because an act does not cease to be required when it is performed, and sometimes an impossible act may be required.

Requiredness itself is not a normative property, but the property of being required is normative; and this is the precise reference of the moral "ought." Moore suggests that the difference between the normative and the factual lies in the peculiar way in which normative properties depend upon and describe their objects. Developing this suggestion, we

formulate the difference between the factual and the normative by pointing out that vector-conferred properties belong to their objects without depending entirely upon them. Rightness, for example, attaches to an act but depends in part upon the situation. This along, however, does not distinguish the normative from the factual, since not all vector-conferred properties are values. We have to add the assertion that the value-making vector demands its object. Value then, is a unique vector-conferred property.

Some features of this account of value might seem to involve the naturalistic fallacy. However, a proper understanding of the nature and function of vectors, especially the relation between the requiredness vector and the rightness it confers upon its object, shows that there is no illicit movement from the factual to the normative.

There are significant differences between logical, esthetic, and moral requiredness; but we direct our attention to moral requiredness as the ground of rightness and duty. The normative function of moral requredness may express itself in many different ways, some of them extremely complex. A distinction between restricted and unrestricted requiredness resolves the problem of apparently conflicting duties. This dissertation also enables us to assert that a moral obligation takes precedence over an esthetic obligation without making art a subdivision of morality; and it also contributes to an understanding of the special nature of forbidden acts.

Moral principles and ideals are not transcendent grounds of moral value. They are generalizations of concrete values. They are immanent parts of moral situations, and they enter into their structure as do other relevant features.

All moral theories which give special relevance to any factors apart from their functional participation in the structure of the situation are rejected. The situation itself is the final authority about what ought to be done.

In addition to functioning as the ground of rightness, moral requiredness enables us to justify our assertion that moral situations are finite observable wholes. Through a process of progressive functional specification it determines both the act that ought to be done and the boundaries of the situation in which that particular act emerges as right. The initial requiredness merely indicates that something is wrong and something ought to be done about it. As the situation develops, its moral structure becomes clear, partly due to the increased knowledge of the moral agent and partly due to the actual temporal ripening of the circumstances.

The question arises as to whether this view of moral situations as finite gestalten gives proper recognition to the relevance of consequences in determining the value of an act. Moore's doctrine of the unrestricted relevance of consequences makes the moral situation identical with the universe, renders knowledge of duty impossible, and violates our sense of resolution when a situation is met with the right act. Actually, consequences are not necessarily relevant, nor are they always irrelevant. They contribute to the value of an act by participating in moral requiredness. They tend to be irrelevant when the moral pattern is such that the consequences of an act are the responsibility of some other person, when there is the possibility of re-entering a situation with another act, and when they are unknown. Ignorance is seen as a dynamic factor in the structure of moral situations; but its relevance does not constitute an invitation to be ignorant, nor does it involve a capitulation to an interpretation of duty that makes duty dependent upon what a person thinks about a situation at the expense of its objective character.

This view of morality does not involve a rejection of what is good in a long range approach to conduct; but in denying that morality is a means to anything beyond itself it places the emphasis upon present conduct. Actions are right or wrong when they are done: they are not made right or wrong by something that happens later on. Morality is now or never; and happiness comes, not as a goal, but as the by-product of right action. 236 pages. $2.95. MicA 55-1129

THE PROBLEM OF APPEARANCE AND REALITY IN SANKARA AND BRADLEY

(Publication No. 11,538)

Ajit Kumar Sinha, Ph.D.
University of Illinois, 1955

An attempt has been made in this dissertation to present a comparative study of the metaphysical systems of Sankara and Bradley. Both Sankara and Bradley maintain that reality is basically spiritual or psychic in its nature when it is viewed from the standpoint of its own essence. Sankara maintains that reality or Brahman is of the nature of pure intelligence or consciousness. Bradley maintains that reality is of the nature of pure experience or feeling. So far the views of Sankara and Bradley are almost identical with the exception that whereas Sankara characterizes reality as pure intelligence, Bradley characterizes it as pure sentience.

Both Sankara and Bradley maintain that nature is appearance. Sankara holds that the world is illusory in its nature. The world is illusory in its nature because we apprehend it with our avidyá or nescience. The ultimate ground of the universe cannot be apprehended through empirical experience. Reality or the world-ground can be known through super-conscious intuition. Bradley, on the other hand, maintains that the universe appears to be structured and differentiated when it is apprehended through discursive thinking. Discursive thinking has the characteristic of analysing an undivided whole into endless part of qualities and relations, and thus, it gets involved in an insoluble relational situation. The appearances, therefore, present a differentiated, fragmentary and self-discordant picture when they are apprehended through relational thinking. But when the universe is apprehended through pure experience or feeling the self-discordant character of the appearances disappear, and the apparent differences become integral

aspects of an undifferentiated whole. Thus, both Sankara and Bradley agree on the point that the appearances are fragmentary, partial and incomplete.

Both Sankara and Bradley maintain that space, time and causality are appearances for they involve discordant elements. They also maintain that God is an appearance. The apparent nature of God is realized when the nature of reality is clearly apprehended. However, both Sankara and Bradley agree on the point that the existence of God and religious experience have significance from the practical point of view.

A subtle point of difference, however, may be observed between the positions of Sankara and Bradley. Sankara maintains that reality is pure identity. Bradley, on the other hand, maintains that reality is identity-in-difference. Notwithstanding this, Bradley gives ample indications to the fact that reality is pure identity without differences. This leads us to the conclusion that in spite of minor differences the systems of Sankara and Bradley are almost identical.

235 pages. $2.94. MicA 55-1130

PHYSICS

PHYSICS, GENERAL

THE MASS AND NUCLEAR MOMENTS OF SELENIUM 75 AND CHLORINE 36

(Publication No. 11,447)

Leonard Corbett Aamodt, Ph.D.
Columbia University, 1955

Eight lines have been observed in the microwave absorption spectrum of $OCSe^{75}$ (carbonyl selenide). The frequency of these lines agree, within experimental error, with those computed for the major lines in the electric quadrupole hyperfine pattern of the $J = 2 \rightarrow 3$ rotational transition, assuming a nuclear spin of 5/2. The spectrum yields the following information regarding the molecular and nuclear constants of the $OCSe^{75}$ molecule and the Se^{75} nucleus: The quadrupole coupling constant of $OCSe^{75}$ is 946.0 ± 0.4 Mc; the electric quadrupole moment of Se^{75} is 1.1 x 10^{-24} cm^2 ± 20%; the mass difference ratio $(m_{Se^{75}}-m_{Se^{76}})/(m_{Se^{75}}-m_{Se^{80}})$ is 0.199566 ± 0.000030; the odd-even mass difference for Se^{75} is 1.5 ± 0.2 mmu; and the spin of the Se^{75} nucleus is 5/2.

The observed nuclear spin does not agree with the spin predicted by the shell model, which is 1/2 or 9/2, and thus Se^{75} presents another definite exception to this theory. Three possible nuclear configurations agree with the observed spin and positive quadrupole moment. These are $[p_{1/2}(g_{9/2})^2]_{5/2}$, $(g_{9/2})^3_{5/2}$, and $(f_{5/2})^5_{5/2}$. The large positive quadrupole moment that was observed agrees better with the estimate of the quadrupole moment for the first configuration, while parity considerations appear to favor the second configuration. The calculated magnetic moments of these three configurations indicate that a magnetic moment measurement could clearly distinguish between them.

Se^{75}, which is an unstable nucleus having a half life of 128 days, was obtained from arsenic through the nuclear reaction $As^{75}(d,2n)Se^{75}$. The Se^{75} was produced in the Brookhaven cyclotron which has a 22 Mev deuteron beam. The Se^{75} was identified by measuring the lines grouped around the 124 Kev and 269 Kev lines in its decay spectrum. The yield indicated an average cross section of the order of 2.7 barns (assuming a 50 mg/cm^2 range). The amount of Se^{75} produced was about 1-1/2 micrograms. Because of dilution and synthesis problems, however, only about 0.07 micrograms of Selenium 75 could be used per spectroscopic run.

The magnetic moment of the Cl^{36} nucleus was measured by observing the Zeeman splitting of the $F = 2 \rightarrow 2$ line in the electric quadrupole hyperfine pattern of the molecule CH_3Cl^{36} (methyl chloride) ($J = 0 \rightarrow 1$, $K = 0$ transitions). The small value of the quadrupole coupling constant in this molecule (-15.8 Mc) made the separation of the three lines in the quadrupole pattern small enough so that the required Zeeman field produced an intermediate coupling situation. This required an exact solution of the secular equations to evaluate the magnetic moment.

The absolute magnitude of the magnetic moment of the Cl^{36} nucleus was found to be 1.32 ± 0.08 nuclear magnetons. The small value of g_J for the CH_3Cl molecule made the determination of the sign impossible with the experimental apparatus used. (The sign determination requires the use of circularly polarized microwave radiation.) The magnetic field was calibrated by observing the Zeeman splitting of the $F = 3/2 \rightarrow 1/2$ line in the quadrupole hyperfine pattern of the molecule CH_3Cl^{35}.

Measurements of the quadrupole spectrum without the Zeeman perturbation gave the following information: The spin of Cl^{36} was confirmed to be 2, the mass difference ratio $(m_{Cl^{36}}-m_{Cl^{35}})/(m_{Cl^{36}}-m_{Cl^{37}})$ was found to be 1.00168 ± 0.04%, the molecular rotational constant of the CH_3Cl^{36} molecule was found to be 13187.604 ± 0.015 Mc, and its quadrupole coupling constant to be -15.83 ± 0.20 Mc.

The magnitude of the magnetic moment indicates that the nuclear configuration is probably either $(d_{3/2})_N(d_{3/2})_p$ or $(s_{1/2})_N(d_{3/2})_p$. The calculated moment of the other possible configurations disagree considerably with the observed value. A determination of the sign of the magnetic moment could distinguish between the two configurations.

54 pages. $1.00. MicA 55-1131

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ACOUSTIC PROPERTIES OF BLOOD AND ITS COMPONENTS

(Publication No. 11,398)

Edwin L. Carstensen, Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. T. H. Wood

An investigation has been conducted to determine the mechanism of the absorption of sound in blood. To obtain the best experimental observations, new techniques for the measurement of the absorption and velocity of sound have been developed. The "absorption difference" technique eliminates the need for field corrections which are a common source of error in conventional methods. The "velocity difference" technique provides increased sensitivity to the extent that it has been possible to study dispersion of the velocity of sound in a number of liquids. Through measurements of absorption and dispersion of velocity of sound in the electrolytes $CoSO_4$ and $MnSO_4$ it was possible to show the applicability of simple relaxation theory in describing the properties of these media. These measurements, beyond their fundamental interest, also demonstrated the reliability of the velocity difference technique.

Experimental measurements covered the frequency range from 0.3 to 10 Mc. Materials investigated include the concentrated red cells of blood, plasma, and dilutions of red cells in plasma and in isotonic, hypotonic and hypertonic NaCl solutions, as well as solutions of hemoglobin at various concentrations, temperatures, pH levels, and from various mammalian species.

Two processes appear to contribute significantly to the absorption of sound in normal blood. The stronger of the two occurs on a molecular level and is associated with the presence of proteins in solution in water. The second mechanism involves the relative motion between the erythrocytes and the water in which they are suspended. The relative motion absorption plays an important role only at low cell concentrations and low frequencies.

The absorption and dispersion in hemoglobin solutions appears to come from a relaxation mechanism in which the relaxing elements have a broad distribution of relaxation frequencies. The absorption per molecule is a constant value at low concentration but increases strongly at high concentration. It appears that the mechanism responsible for the absorption involves an interaction between the protein molecule and its environment, very likely a protein-water interaction. 118 pages. $1.48. MicA 55-1132

THE HIGH-RESOLUTION INFRARED SPECTRA OF TRANS-DICHLOROETHYLENES

(Publication No. 11,269)

Thomas Harvey Edwards, Ph.D.
University of Michigan, 1955

This research is concerned with the fine structure of the infrared spectra of trans-dichloroethylene and its deuterated forms. Although these molecules are asymmetric rotators, the degree of asymmetry is sufficiently slight to allow initial classification as a symmetric top rotator. Thus changes in electric moment along the axis of minimum moment of inertia I_A correspond to parallel bands of a symmetric top molecule, while changes of electric moment along the intermediate (I_B) and maximum (I_C) moment of inertia axes correspond to perpendicular bands.

Using a high resolving-power grating spectrometer, the spectra of trans-$C_2H_2Cl_2$, trans-$C_2D_2Cl_2$ and trans-C_2HDCl_2 have been obtained in the region from 600 to 3200 cm^{-1}. Fifteen strong bands assigned to fundamental frequencies were investigated. Four of these correspond to out-of-plane vibrations and are truly perpendicular bands. The behavior at the center of these bands, where the four central Q branches are missing, and a strong central absorption is found, has been shown to be a consequence of asymmetry. A band near 900 cm^{-1} (ν_6Au of trans-$C_2H_2Cl_2$) is anomalous in that it contains several discrete lines which appear to be associated with each of the Q branches. It has not been possible to explain these on the basis of current theory. The remaining eleven bands correspond to in-plane vibrations and as such they may contain both parallel and perpendicular components. Seven of them show a purely parallel structure in which the spacing of the lines in the P and R branches was too small ($\approx .1$ cm^{-1}) to be resolved in this investigation. An interesting anomaly arises in that some of these parallel bands appear to have too many Q branches. The four remaining bands are hybrid bands showing both parallel and perpendicular structure. Each of these bands contains more than one series of lines, due to the chlorine isotope effect. Of the eight perpendicular bands or perpendicular components of hybrid bands only one (ν_6Au of trans-$C_2H_2Cl_2$) had been observed before and none of the parallel band Q branches had previously been resolved.

At least one series of perpendicular band Q branches was found (in the hybrid bands) and analyzed for each of the following isotopic isomers of trans-dichloroethylene: trans-$C_2H_2Cl_2^{35}$, trans-$C_2H_2Cl^{35}Cl^{37}$, trans-$C_2D_2Cl_2^{35}$, trans-$C_2D_2Cl^{35}Cl^{37}$, trans-$C_2HDCl_2^{35}$ and trans-$C_2HDCl^{35}Cl^{37}$. From this analysis the vibrational frequency ν_0 was obtained, together with the rotational constant $A - \frac{B+C}{2}$ for both the upper and lower energy states involved in each band. From these results it is not possible to fix all the molecular dimensions, but, using the results for trans-$C_2H_2Cl_2^{35}$,

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trans-$C_2H_2Cl^{35}Cl^{37}$, trans-$C_2D_2Cl_2^{35}$ and trans-$C_2D_2Cl^{35}Cl^{37}$, together with certain data from electron-diffraction work, revised values were obtained for the C-H and C=C distances and the C=C-Cl angle.

The high-resolution spectra in the 600 to 3200 cm^{-1} region serve to confirm the existing assignments of fundamental frequencies in these molecules, which had been made earlier on the basis of low-resolution spectra. However, more accurate values were determined for the frequencies. The revised values obtained for the molecular dimensions are:

C-H distance	1.084 A^0
C=C distance	1.377 A^0
C=C-Cl angle	$121^0\ 53\frac{1}{2}'$

Both the C-H and C=C distances are significantly larger than the presently accepted corresponding values for ethylene of 1.072 and 1.353 A^0.

166 pages. $2.08. MicA 55-1133

ON THE THEORY OF LINEAR GRAPHS WITH APPLICATIONS TO THE THEORY OF CONDENSATION

(Publication No. 11,277)

George Willard Ford, Ph.D.
University of Michigan, 1955

In the Mayer theory of the virial expansion of the equation of state each coefficient in the expansion is itself a sum of a number of terms, each of which can be associated with a configuration of points and lines called a linear graph. The problem of determining the coefficients in this expansion is seen to split naturally into two parts; one, the counting problem, is the problem of determining the kind and number of terms which contribute to each coefficient, the other, called the integral problem, is the problem of determining the numerical value of each of these terms. The principal advantage of the formulation in terms of linear graphs is that it simplifies the counting problem, reducing it to the problem of counting the number of linear graphs of a certain kind.

The first part of this thesis, Chapters II and III, is devoted to a general discussion of this counting problem for various kinds of graphs. In Chapter II the solutions to a number of counting problems for graphs with distinguishable points as well as for topological types of graphs are presented in the form of relations between the counting series. Implicit equations are developed for the counting series for the number of star trees which can be constructed out of a given collection of topological types of stars. Chapter III is devoted to the problem of the asymptotic numbers of graphs when the number of points is large. It is shown that a sufficient condition for the convergence of the star tree counting series is that the stars out of which the star trees are constructed have no more than a fixed number of cycles.

Finally, in Chapter IV the theory of condensation in non-ideal gases is considered from the point of view of Mayer and Kahn. In this theory the asymptotic behavior of the coefficients in the Mayer expansion determine the existence and nature of the condensation point. Some progress is made with the integral problem through the introduction of a special model, the Gaussian model, for the interaction function. Using the results on the counting problem from Chapters II and III a number of conclusions concerning condensation in non-ideal gases are reached. The principal results are:

i) For a gas of particles with purely attractive forces the Mayer expansion diverges.

ii) If the forces between the gas particles are attractive with a repulsive core then at very low temperatures, under the assumption that only those terms which correspond to a restricted sub-collection of all graphs contribute, it is demonstrated that condensation will occur. The condensation will be of the Bose type with $\frac{\partial p}{\partial v} = 0$ at the condensation point.

iii) For a gas with purely repulsive forces it is shown that the Mayer expansion converges but it cannot be stated at this time whether or not condensation occurs.

128 pages. $1.60. MicA 55-1134

THEORY OF PLASMA OSCILLATIONS

(Publication No. 10,912)

Eugene Paul Gross, Ph.D.
Princeton University, 1949

Abstract not available.

144 pages. $1.80. MicA 55-1135

THE DESIGN AND EVALUATION OF A ONE YEAR LABORATORY SEQUENCE IN ELEMENTARY PHYSICS FOR NON-SCIENCE CONCENTRATORS

(Publication No. 11,872)

Robert John Hart, Ph.D.
Syracuse University, 1955

An investigation of the relative effectiveness of the non-directive method and the conventional method of laboratory instruction in physics was conducted at the College of William and Mary in the session 1953-54. Laboratory instruction of the two types was given to two separate groups of students from an elementary course for non-science majors.

Detailed instructions, laboratory manuals and appropriately labeled data sheets were supplied to students in one group and a procedure believed typical of many elementary laboratories was followed. In general, procedure to be followed in the investigation of a problem was rather completely defined.

Approximately the same material was investigated by students in the second group. A sequence of

experiments was locally prepared with the purpose of development of ideas of experimental procedure, consideration of all influential factors, realization of the difficulty of application of apparently simple theory to practice, and a critical attitude towards experimental results. Attainment of these objectives was implemented by a procedure placing maximum reliance on student thought and initiative. Instructions were minimized, no data sheets were furnished and little or no printed material was furnished the students.

A brief presentation of the problem and occasionally a review of the principles involved was given at the beginning of each problem for this second group. Students were expected in most cases to devise their own procedure and the instructor usually acted only to settle controversies or to provide guidance for groups in difficulty.

The methods of laboratory instruction were evaluated in their attainment of three objectives:

A. Factual knowledge of material and the nature and structure of scientific inquiry.
B. Ability to apply methods of science.
C. Ability to interpret elementary scientific information.

Evaluation was accomplished by means of an objective paper and pencil test and a laboratory examination. The former was administered as a pre-test and as a part of the final examination of each semester. This examination was locally prepared and was composed principally of items from a manual by Nedelsky - selected for their pertinence to the previously stated objectives of the laboratory. Scores on the pre-test and on the Ohio State College Aptitude Examination were used to confirm the original equivalence of the two groups.

The laboratory test, administered at the end of the second semester, required the establishment of hypotheses and the determination of procedures in new problems and the evaluation of furnished results and data by each student.

Comparison of mean scores by use of the critical ratio test failed to produce any statistically significant evidence of difference in the attainment of the stated objectives of the laboratory by the two methods. It was impossible to determine to what degree the statistically significant gain in mean score for the entire class was attributable to the laboratory as it was impracticable to provide a control group without laboratory experience.

The experiences of the staff during the investigation appeared to point out the superiority of the non-directive method in the area of student initiative, interest, and motivation. Despite the lack of quantitative evidence it was felt that students in this type of laboratory experience profited by the development of improved habits of initiative and profit from errors.

In summary, there appears, as a result of this investigation, to be no evidence of the superiority of either method of laboratory instruction in the attainment of such objectives as were selected for quantitative study, but there is some subjective evidence of benefits other than these to be acquired from the use of the non-directive approach.

256 pages. $3.20. MicA 55-1136

THEORETICAL STUDY OF THE AUGER EFFECT IN THE LIGHT TO MEDIUM RANGE OF ATOMIC NUMBER

(Publication No. 11,532)

Richard Alan Rubenstein, Ph.D.
University of Illinois, 1955

An improved theoretical treatment of the non-relativistic Auger effect in the range of low to medium atomic numbers has been given, using Slater shielded hydrogenic wave functions for bound electron states and shielded positive energy coulomb functions for the free Auger electron. In the derived expression for the transition amplitudes the shielded constants of the electrons participating in the process appear explicitly so that the treatment is not confined to the K-series transitions. This expression, although in closed form, involves functions which have not been tabulated and are difficult to estimate.

Therefore a numerical calculation of the various Auger transitions in the atoms argon (Z = 18), krypton (Z = 36), and silver (Z = 47) has been carried out. X-ray dipole transitions have also been calculated. In each case the orbital electrons were assumed to move in a common central field obtained by an application of the Hartree self-consistent field method. All calculations were carried out on the high speed Electronic Digital Computer of the Graduate College, University of Illinois.

For each of the above atoms, the K-series fluorescence yield is calculated and compared with experiment. The agreement between theory and experiment is to within five percent, and the theoretical estimates are fairly consistent with the results of earlier workers.

The calculated transition rates for argon are applied to an analysis of a recent experiment of Kofoed Hansen. In this experiment, the distribution-in-charge on the recoil ions, following K (or L) capture by A^{37}, is measured. Theory and experiment are found to agree for all but the distribution of singly and doubly charged ions. The discrepancy is ascribed to inadequate theoretical treatment of the shakeup process rather than to a deficiency of the current theory of the Auger effect.

121 pages. $1.51. MicA 55-1137

PARAMAGNETIC RESONANCE ABSORPTION OF COPPER AND VANADIUM IONS IN AMORPHOUS PHASES

(Publication No. 11,571)

Richard Hamilton Sands, Ph.D.
Washington University, 1954

Chairman: George E. Pake

Chance observations of paramagnetic resonance absorption in glass led to a detailed study of such absorption in numerous glass samples of varying

compositions furnished by the Corning Glass Works, Corning, New York.

Of the absorptions recorded, those from titanium, vanadium and copper were analysed. Experimental work on the resonance resulting from the cupric ions in network-modifying positions in a soda lime-silica glass showed that even in complex glasses there is strong short-range order. The spectroscopic parameters obtained for the copper were in excellent accord with those reported for the Tutton salts.

Resonance absorptions occurring with spectroscopic splitting factors of 4 and 6 were noted in all glasses studied. These were apparently anisotropic g-values for a specific impurity and the peaks recorded were a result of a distribution of Stark fields over all directions in the glass.

In an attempt to understand better the properties of the vanadium ion in glass, a study of the oxidation-reduction states of vanadium in the liquid phase was undertaken. From this, several interesting facts became apparent. For the first time, the expected dependence of orbital promotion on the environment of the ion was observed for complexes formed in ether, acetone and water. Furthermore, these solvents had the required range of viscosities to yield not only the motionally narrowed absorption lines at one temperature but also the broader anisotropic g-value distribution at lower temperatures. Here, interestingly enough, the critical frequency for the motional narrowing was the Larmor frequency. A systematic investigation of these line widths versus temperature was reserved for a later time, however. Data pertinent to the assignment of static susceptibilities to the oxidation-reduction states of vanadium was also recorded.

The investigation showed the applicability of the theories of Bleaney and Ingram to paramagnetic resonance absorption in glasses. A review of the theoretical considerations has been included in the dissertation as well as a treatment of the required microwave electronics patterned after that of Slater. There is considerable evidence that paramagnetic resonance may be a useful tool in glass technology as well as in the assignment of the valence states of paramagnetic ions. 132 pages. $1.65. MicA 55-1138

A QUANTUM STATISTICAL THEORY OF LIQUID HELIUM

(Publication No. 11,850)

Rudra Pal Singh, Ph.D.
State College of Washington, 1955

The properties of the three states of aggregation of matter--solid, liquid and gaseous--have received the attention of the theorists for a long time. At present we have sufficiently good workable theories for the solid and the gaseous states, but we do not have a single completely satisfactory theory of the liquid state, which will explain all the properties of all the liquids. Most of the theories of the liquid state are based on some sort of models and the chief among them are:

(1) Lattice, cage-like or solid-like models.
(2) Trapped gas or gas-like models.
(3) Hole Theory of Liquids.

Recently there have been attempts at more exact theories of the liquid state starting from the first principles but their success is very limited.

The modelistic theories of the liquid state are based on the fact that a liquid should behave almost like a solid near the freezing point and almost like a gas near the critical point. These theories have some success in the regions for which they are designed.

In the present work, an attempt has been made to combine the solid-like and gas-like models into a single model which we can call a "solid-gas" model. The molecules of the liquid are supposed to spend a part of their time in the gas-like states and a part of it in the solid-like states, and there is an equilibrium between them. This temporal behavior of the molecules is statistically equivalent to saying that a fraction of the total number of molecules are in solid-like states and the rest in the gas-like states.

An attempt is then made to fix the ratio β of the number of molecules in the solid-like to those in the gas-like states. As it is desired to apply this proposed model to liquid Helium, we consider the gas-like states to form a quantum degenerate gas and the solid-like states to form a Debye solid.

Detailed calculations, based on this model, show that it fits in very nicely both for liquid He^4 and liquid He^3. 108 pages. $1.35. MicA 55-1139

EFFECT OF ANTIMONY IMPURITY ON SELF-DIFFUSION OF SILVER

(Publication No. 11,544)

Edward Sonder, Ph.D.
University of Illinois, 1955

To determine the nature and extent of effects of solutes on diffusion in low concentration alloys, diffusion coefficients for Ag^{110} and Sb^{124} in single crystals of alpha silver antimony were measured over a temperature range of 450 - 900°C and for antimony concentrations up to 1-1/2 percent.

Alloy crystals were grown by a Bridgeman technique from 99.99% pure Ag and 99.9% pure Sb. Diffusion anneals were performed in furnaces whose temperatures were held constant to .5°C. To determine the diffusion coefficients, radioactive tracer counting and sectioning techniques were used for all samples.

Results of self diffusion measurements above 550°C show that in dilute silver-antimony alloys the Arrhenius Equation,

$$D = D_0 \exp -Q/RT ,$$

where D is the diffusion coefficient, R is the universal gas constant, T is the absolute temperature, and D_0 and Q are constants, is obeyed. The two constants were found to depend upon the amount of Sb in the

lattice, decreasing by 25% and 1-1/2 Kcal respectively per percent added Sb. For the case of diffusion of Sb in dilute Ag-Sb alloys, impurity effects were found to be appreciably smaller.

Measurements below 550°C yielded what seemed to be anomalously high values for the diffusion coefficients. These are in part accounted for by small voids that were observed in a number of samples.

The data give qualitative support to theories of Lazarus (D. Lazarus, to be published) and Overhauser, (A. Overhauser, Phys Rev. 90, 393 (1953)) which attempt to predict impurity effects on the basis of changes in mobility energy.

51 pages. $1.00. MicA 55-1140

A THEORY OF GRAVITATION AND ITS QUANTIZATION

(Publication No. 11,668)

James Calvin Swihart, Ph.D.
Purdue University, 1955

Major Professor: Frederik J. Belinfante

A phenomenological classical gravitational theory within the framework of special relativity is presented. The field equations are linear and derivable from a Lagrangian. The classical field is quantized in interaction with Dirac and Maxwell fields.

Five real constants occur which are to be adjusted so that the classical theory will fulfill the following conditions:

(1) That the gravitational field produced by a point mass at rest be time-independent, and not only spherically symmetric about the point mass, but also be an "isotropic" tensor at each point.

(2) That for small planets moving around a heavy point mass, the theory be Newtonian in the first approximation.

(3) That the theory agree with the observational data concerning the advance of the perihelion of Mercury, the deflection of light rays by the sun, and the gravitational red shift of spectral lines.

These conditions (except for the red shift) were fulfilled, and this established four relations between the constants, leaving one constant arbitrary. The red shift, due to the second condition, was automatically fixed to agree with general relativity; however, it is doubtful that this is in agreement with observation. Three of the constants can be set equal to zero and the remaining two can still be adjusted so that the first two conditions are fulfilled and the theory gives the proper advance of the perihelion. Then the deflection of light is automatically determined and seems to be in somewhat closer agreement with observation than the prediction of general relativity.

The classical fields are then quantized in the Heisenberg representation. The canonical variables, the commutation relations, and the Hamiltonian are determined. The canonical commutation relations are shown to be time-independent.

A transformation is made to the interaction representation, which is shown to exist by the fact that the integrability condition is satisfied. The Lorentz-transformation properties and the equations of motion of the field variables in the interaction representation are determined. The Lorentz-covariance of the commutation relations and equations of motion is proved.

The gravitational field variables are expanded in terms of creation and annihilation operators. Among the free-field gravitons, some occur with negative energy. Therefore, states of negative energy must somehow be eliminated. By introducing an indefinite metric and an auxiliary condition in which field variables in the interaction representation operate on the Heisenberg state vector, all states of negative free-graviton energy are eliminated for the incident particles. Whether or not they are also eliminated for the outgoing particles is as yet an unsolved problem.

171 pages. $2.14. MicA 55-1141

A STUDY OF THE EFFECTIVENESS OF SEVERAL METHODS FOR OBTAINING THE CHARACTERISTIC VALUES AND VECTORS OF SYMMETRIC MATRICES

(Publication No. 11,233)

Norman Ralph Zabel, Ph.D.
The University of Nebraska, 1955

Adviser: Herbert Jehle

There are a large number of known methods for the numerical calculation of the eigenvalues and eigenvectors of finite matrices, and each of these methods has its own individual merits and deficiencies. Before beginning a series of computations it is desirable to be able to select the procedure which not only is of minimum length and difficulty, but also affords a means of assuring the reliability of an extension at any point in the development. Several methods, those apparently the most promising, have been examined in detail for their practicability in conjunction with a desk calculator for obtaining all or part of the diagonal transforms, under orthogonal transformations, of symmetric matrices. Several criteria were suggested, by means of which the methods, differing widely in principle of generation, could be readily compared, furnishing significant information toward the actual selection of a particular approach to any given problem.

Although special conditions and requirements of specific matrices may give occasion to the preferability of one of the other methods, it was found that successive changes of basis consisting of two-dimensional rotations are economically effective in the diagonalizing transformation of a symmetric matrix. Furthermore, near-degeneracy of the eigenvalues induces substantial complication in most other methods, particularly in the series expansion approach, which becomes completely ineffectual; the method of rotations requires no significant extension.

Considerable abbreviation and facilitation of the operations involved in this method are made possible by the use of two tables of function values, which were evaluated to accomplish approximate rotations. Machine programs, applying to a Monroe fully automatic desk calculator, were developed to assist in the computation of the function values as well as to show the use of the values in the process of diagonalization.

One of the applications of these calculations is the determination of the set of normal frequencies, i.e., the energy spectrum necessary for the computation of partition functions relative to the specific interaction of macro-molecules.

140 pages. $1.75. MicA 55-1142

PHYSICS, ELECTRONICS AND ELECTRICITY

THE ELECTRICAL PROPERTIES OF GERMANIUM SEMICONDUCTORS AT LOW TEMPERATURES

(Publication No. 11,629)

Hellmut Fritzsche, Ph.D.
Purdue University, 1954

Major Professor: K. Lark-Horovitz

Low temperature anomalies in the Hall coefficient and resistivity - a steep maximum and a change of the slope of the log resistivity versus 1/T curve in germanium semiconductors - which were first observed by Hung and Gliessman, have been reinvestigated at temperatures between 1.5°K and 300°K using single crystals of n- and p-type germanium of various impurity concentrations. The influence of contacts and of various surface treatments has been studied. It was found that the effects observed cannot be explained by surface conduction. To exclude electrical field effects at low temperatures, fields well below the breakdown field have been used. The Hall coefficient was measured with magnetic fields ranging from 200 to 3500 gauss. Measurements on crystals cut in different crystal orientations show that the anomalies cannot be due to orientation effects. In the same temperature region where the Hall effect and resistivity become anomalous, the magnetoresistive ratio also shows a drastic change. The results indicate that in order to describe the observations it seems necessary to assume conduction in at least two bands, the regular conduction band (valence band in the case of p-type material) and one band with a very small mobility. Hung's model of impurity band conduction has to be refined considerably or altered to account for the complicated behavior of p-type germanium with more than 2×10^{18} gallium atoms per cubic centimeter.

117 pages. $1.46. MicA 55-1143

THEORY OF A POSSIBLE RELAXATION EFFECT IN THE ELECTRICAL CONDUCTIVITY OF SEMICONDUCTORS AT HIGH FREQUENCIES

(Publication No. 11,408)

Bernard Goodman, Ph.D.
University of Pennsylvania, 1955

Supervisor: P. H. Miller, Jr.

The theory and some numerical calculations are presented for a relaxation effect to be expected in the electrical conductivity of semiconductors. The effect is associated with the relatively long relaxation time of the phonon system which causes most of the lattice-scattering resistivity. The phonons are displaced in the direction of the charge carrier drift when a current flows. The displaced phonon distribution causes a change in the electrical resistivity which is of second order in the phonon-charge carrier coupling parameter.

The first order effect is the phonon contribution to the Peltier heat for which Herring has developed a quantitative theory which provides the numerical value of a parameter necessary for the calculation of the electrical resistivity change.

The variation of the conductivity with frequency is like that of a simple relaxation process. The conductivity will fall at high frequencies to the value for a phonon system in equilibrium. An out-of-phase component will also appear in this frequency range. The total change in conductivity is rather small, being limited at low temperatures by the dominance of impurity-scattering and at high temperatures by the decreasing phonon relaxation time.

Numerical calculations were made for p-type silicon in which the relatively low intrinsic mobility indicates the largest phonon-charge carrier coupling. Moderately high acceptor concentrations are required to displace the phonons appreciably. The relative contribution of the phonon displacement effect to the total conductivity is only about five percent. At a fixed frequency, the small out-of-phase component will increase and then decrease as the temperature is raised. This seems to offer the main possibility of detection by an accurate measurement of the phase of microwaves reflected from a thin sample.

121 pages. $1.51. MicA 55-1144

THE PERIODIC HALL EFFECT IN METALS AT LOW TEMPERATURES AND HIGH MAGNETIC FIELDS

(Publication No. 11,612)

Edward George Grimsal, Jr., Ph.D.
Louisiana State University, 1955

Supervisor: Professor J. S. Levinger

A preliminary discussion is given of the existence, in certain effects in a magnetic field, of components

which are quasi-periodic in the reciprocal of the magnetic field. Three of the more important effects so far discovered to have this property are the magnetic susceptibility, the conductivity, and the Hall effect. The dependence of each of these effects on the number of free electrons is discussed. An expression is then derived, predicting oscillations in the number of a small but special group of electrons. With the aid of approximate formulae for the above effects, expressions are obtained for the oscillations in each effect. The relative magnitude and phase of the oscillations in each effect is discussed and compared with experiment. Qualitatively, the agreement is good, and some semi-quantitative agreement with experiment is obtained. The Hall effect data obtained in this laboratory are analyzed by this theory, with good internal agreement. An attempt is made to improve the formula used for the Hall effect, but although two new expressions are obtained in special cases, no better agreement with experimental results is obtained. 71 pages. $1.00. MicA 55-1145

WORK FUNCTION DIFFERENCE OF REDUCED AND OXIDIZED GOLD FROM CONTACT POTENTIAL DIFFERENCES WITH RESPECT TO GERMANIUM AND PLATINUM

(Publication No. 11,422)

Paul Miller, Ph.D.
University of Pennsylvania, 1955

Supervisor: Park H. Miller

An apparatus has been developed for making twenty-five contact potential difference measurements by the Kelvin method in one second — useful for getting the value characteristic of a treated surface before its contamination by the ambient gases. The extension here of the Kelvin method to rotational geometry allows study of several samples at once, with access for treatment in situ, because the reference electrode is in front of a given sample for only a small fraction of the rotational period.

The work function difference between massive polycrystalline gold oxidized by heating in air and gold reduced by heating in hydrogen has been found to be 1.06 $\pm$ 0.08 volts, in agreement with a photoelectric determination by Weiss.

Attempts to measure the dependence of the work function of germanium on crystal face were unsuccessful (111, 100, and 110 specimens being studied at the same time) on account of artifacts from the methods tried for cleaning the germanium, namely, heating by electron bombardment and reduction by active hydrogen from a nearby discharge.

110 pages. $1.38. MicA 55-1146

THE INFLUENCE OF TIME-DEPENDENT ELECTRIC FIELD GRADIENTS UPON THE ANGULAR CORRELATION OF GAMMA RAYS INVOLVING THE 480-kev STATE OF Ta^{181}

(Publication No. 11,651)

Helmut Paul, Ph.D.
Purdue University, 1955

Major Professor: R. M. Steffen

The use of angular correlation as a tool in nuclear spectroscopy is limited by the existence of extra-nuclear fields which may influence the correlation if the half-life of the intermediate state is more than about 10^{-9} sec. In order to obtain the undisturbed gamma-gamma angular correlation from which the spin values and the multipole orders of the cascade can be deduced, one has to measure the correlation of the nucleus in some environment that shows only small interaction, and extrapolate to zero interaction. This can be done by the method of delayed coincidences, if a fast enough coincidence circuit is available, or by using liquid sources of different viscosities. Here, the latter approach was used to investigate the time-dependent interaction of the randomly fluctuating electric field gradients in various liquids, with the 480-kev state of Ta^{181}.

A brief description of both the theory of angular correlation and of the theory concerning interaction of nuclei with external fields is given, without complete mathematical derivations.

The excited states of Ta^{181} that occur subsequent to the decay of Hf^{181} are at 612 kev ($T\frac{1}{2}$ = 22 microseconds), 480 kev (11 millimicroseconds), and 136 kev (less than 1 millimicrosecond) above the ground state. F. K. McGowan (Phys. Rev. 93, 471, 1954) has assigned spin and parity values to all the excited states, and multipole characters to the gamma transitions. His assignment appears to be inconsistent with the partial life-time of the 612-kev transition which, on the basis of this assignment and of the Weisskopf formula, should be about 10^5 times faster than observed.

A new spin and parity assignment is proposed which would remove the inconsistency: 1/2 + (612 kev), 5/2 + (480 kev) and 9/2 + (136 kev), with the multipole assignments:

132 kev:	1/2 (E2) 5/2	
480 kev:	5/2 (E2 + M1) 7/2	$\delta = 6$
344 kev:	5/2 (E2) 9/2	
136 kev:	9/2 (E2 + M1) 7/2	$\delta = 0.5$

This assignment agrees fairly well with McGowan's data (and with ours, for the 132-480 kev cascade). Whereas McGowan had to assume a strong interaction in the 480-kev state, we are led to attenuation coefficients (in the Legendre polynomial representation) $G_2 = 0.95$ and $G_4 = 0.92$, i.e., much smaller attenuation.

To investigate the interaction directly, an angular correlation apparatus was used which consists of two scintillation spectrometers with single channel pulse selection, a "fast" (t_e = 0.1 microsecond) double coincidence circuit and a "slow" (t_e = 4 microseconds)

triple coincidence circuit which selects coincidences between the double coincidences and the selected single pulses. The apparatus records data and changes the angle automatically.

Neutron-bombarded HfO_2-sources (from the Isotopes Division of the USAEC at Oak Ridge) were dissolved in various acids; hafnium fluoride dissolved in water was also used. The following anisotropies (uncorrected for finite solid angle) were measured for the 132-480 kev correlation in solvents of viscosity η:

20% HCl	27°C	η = ~1.3 cP	$A' = -0.185 \pm 0.006$
98% H_2SO_4	26°C	η = 22 cP	$A' = -0.136 \pm 0.003$
98% H_2SO_4	300°C	η = ~ 1 cP	$A' = -0.286 \pm 0.006$
50% HF	26°C	η = 0.8 cP	$A' = -0.366 \pm 0.003$
68% HNO_3	28°C	η = ~1.6 cP	$A' = -0.072 \pm 0.017$
100% H_2O	26°C	η = 0.88 cP	$A' = -0.311 \pm 0.011$

The attenuation is different in different liquids of equal viscosity, at the same temperature; this might be due to different field gradients at the nucleus, in different complexes. If the anisotropy in water is measured at different temperatures, plotted versus η/T and extrapolated to $\eta/T = 0$, the A′ obtained agrees very well with our spin assignment (weak perturbation in the 480-kev state), but not with McGowan's; the curve corresponds to a quadrupole interaction frequency of only about 5 Mc (assuming a complex radius of 10^{-8} cm). On the same basis of the theory of time-dependent interactions, however, the curve of A′ as a function of η/T for H_2SO_4 leads to a value (for $\eta/T = 0$) smaller by 30% than the value for H_2O, a fact which is not understood.

93 pages. $1.16. MicA 55-1147

the order of 10^{-7} seconds with some displaying even faster response times.

Both electrical and optical properties of this device have been studied. These include the dependence on light intensity, wavelength, external resistance, temperature, and electrical bias. Some physical damage due to temperature cycling prohibits detailed studies of the photo-properties at other temperatures but studies were made on temperature cycled samples after reproducibility in the measurements could be obtained.

The dependence on light intensity fits the relation $L \sim [\exp(\beta e V/kT) - 1]$ with $\beta = 1$ at room temperature but proportional to T at other temperatures. The fast response time observed is not yet understood but it seems unrelated to the carrier bulk lifetime.

Some electrical properties of the photocell have also been studied. The device's rectifying properties were fit to the empirical rectifier equation

$$L \sim [\exp(\beta e V/kT) - 1]$$

with $\beta = 1/2$. The rectification β and the photovoltaic β do not agree with each other at room temperature and the rectification β seems to be independent of T.

Some photovoltaic theories have been discussed and an equivalent circuit for the photocell has been presented. The type of contact developed for this device should prove useful in the basic study of the metal-semiconductor surface barrier as this contact can be used to make optical and well as electrical measurements of the barrier properties.

109 pages. $1.36. MicA 55-1148

AREA GERMANIUM PHOTOVOLTAIC CELLS

(Publication No. 11,661)

Edward Simon, Ph.D.
Purdue University, 1955

Major Professor: Ralph Bray

The purpose of this investigation was to develop and study a germanium photodetector with special properties that existing commercial photocells do not have. An area germanium photovoltaic cell sensitive in the near infrared has been developed. Of several fabrication methods investigated, electrolytic stream etching and plating technique gives the highest reproducibility of acceptable photocells and is described in this paper in detail.

The front wall surface barrier photocell has several advantages over commercial germanium junction photocells. Its sensitive area has been made up to 1 cm^2 with uniformity of ± 0.5 db to a 0.1 mm diameter light spot. The active area can be made into any desired shape or composed of a mosaic of sensitive elements. The sensitivity or the signal to noise ratio is comparable to that obtained in practice for commercial P-N junction photocells. The speed of response or many of these units has been found to be of

MECHANISM OF THE TERMINATION OF THE GEIGER PLATEAU REGION

(Publication No. 11,891)

Herbert Louis Wiser, Ph.D.
University of Maryland, 1954

Supervisor: Professor Aaron D. Krumbein

The problem of this thesis was to determine the mechanisms responsible for the termination of the Geiger counter plateau at its high-voltage end. A search of the literature revealed little prior work on this problem and no adequate explanation of the breakdown in either theory or experimental results.

A direct experimental approach was devised — one of operating a Geiger counter in a normal manner and collecting data of counting rate versus voltage and number of positive ions per pulse versus voltage in the breakdown region.

Counter assemblies were designed for easy access to the cathode for the prime purpose of using the same surface for cathodes of various radii and thereby eliminating experimental deviations caused by different surface structures. The main components were the following: (a) brass cathodes; (b) tungsten wire anodes; (c) argon and neon vehicle gases; and (d) ethyl alcohol and ethyl acetate quenching vapors.

Analysis of the data collected during operation of the counters indicated that spurious counts could result from two phenomena — secondary electrons created by positive-ion bombardment of the cathode, and metastable atom and molecule collisions in the gas. The rate of spurious counts caused by positive-ion bombardment was found to be proportional to the rate of positive ions striking the cathode and, therefore, proportional to the voltage. This accounted for the plateau slope and the slight rise in slope at the beginning of the breakdown region, but it could not explain the almost exponential rise in counting rate actually experienced in the breakdown region.

The rate of spurious counts, caused both by collisions of metastable atoms and molecules with other gas particles, and by the spontaneous decay of metastable molecules, appeared to depend on the number of metastables, atoms or molecules, that existed after the deadtime of the primary pulse in the Geiger counter. The decay of metastables followed an exponential law; therefore, the number of metastables existing after the deadtime was an exponential function of the ratio of the deadtime to the metastable mean-life. Since the deadtime decreased with increasing voltage, the rate of spurious counts caused by metastables was an exponential function of voltage. Therefore, termination of the plateau was caused primarily by metastable atom and molecule collisions and metastable molecule spontaneous decay giving rise to spurious counts.

Experimental results indicated further that metastable atoms were dominantly responsible for spurious counts at low pressures (about 40 mm Hg) and that metastable molecules were dominantly responsible for spurious counts at high pressures (200 mm Hg); at intermediate pressures, both metastable atoms and metastable molecules contributed significantly. 61 pages. $1.00. MicA 55-1149

PHYSICS, NUCLEAR

ANGULAR DISTRIBUTIONS IN (d,p) REACTIONS WITH Na^{23}, Ti^{47}, AND Ti^{48}

(Publication No. 11,555)

Manuel Martin Bretscher, Ph.D.
Washington University, 1954

Chairman: Franklin D. Shull

Thin targets of Na_2CO_3, NaOH, and TiO_2 (one with Ti^{47} enriched to 82 per cent, another with Ti^{48} enriched to 99 per cent) were bombarded with 10.2 Mev deuterons from the Washington University cyclotron. Proton angular distributions were determined by a photographic method. Aluminum foils placed in front of nuclear emulsion plates served as energy selectors, so that proton groups from the various excited states of the product nucleus could be studied separately. Comparison with Butler's theoretical curves established the angular momentum $\ell_n \hbar$ for the captured neutron, from which the spin and parity of the final nuclear level may be determined. The spin-parity results obtained in this manner for the various states of the residual nucleus have been compared with any existing information regarding these nuclear parameters.

For the $Na^{23}(d,p)Na^{24}$ reactions the observed ℓ_n values are 2, 2, 0, and 0 corresponding to Q values of 4.731, 4.259, 4.167, and 3.390 Mev. All these residual states were found to have even parity.

For the $Ti^{47}(d,p)Ti^{48}$ reactions the observed ℓ_n values are 3, 1, 1, and 1 corresponding to Q values of 8.14, 6.81, 5.83, and 4.83 Mev. Each state of the final nucleus was found to have even parity.

For the $Ti^{48}(d,p)Ti^{49}$ reactions the observed ℓ_n values are 3, 1, 1, and 2 with corresponding Q values of 5.81, 4.46, 4.11, and 3.40 Mev. Except for the last state, each level of the product nucleus was found to have odd parity. 151 pages. $1.89. MicA 55-1150

A CLOUD CHAMBER STUDY OF LOCAL PENETRATING SHOWERS

(Publication No. 11,618)

Gustavo del Castillo y Gama, Ph.D.
Purdue University, 1954

Major Professor: Dr. W. Y. Chang

Experiments for investigating the production mechanism of Penetrating Showers originated by collisions between cosmic ray nucleons with nucleons of absorbing materials such as Be, C, and Pb were performed at Purdue University.

In a preliminary experiment a twelfth-inch cylindrical cloud chamber was used. This was operated by counter control using five channels in coincidence, two of them being arranged as a shower detector. Inside the chamber two Be plates (4.8 g/cm^2 each) and one Pb plate (17 g/cm^2) were used to produce and identify the shower particles. Above the chamber a carbon block (43 g/cm^2) was placed during the first six months also to produce showers. The carbon block was later replaced by an equivalent amount of Pb for the last five months of operation. The Be plates remained inside the chamber for all the eleven months. Below the chamber a Pb block (110 g/cm^2) was used to bias for shower particles of corresponding energies before reaching the last counter tray of the telescope.

The presence of missing-link showers associated with the penetrating showers has given evidence that neutral π mesons are also produced among the shower particles. Single scattering events of the penetrating particles have led to the conclusion that these particles must be mesons and protons.

According to a suitable definition of a penetrating shower, there were 63, 84 and 73 showers selected respectively from Be, C and Pb. From these, the

shower-particle multiplicity, angular distribution and absorption mean free path of the penetrating particles were obtained. The values of the multiplicity are found to be 2.5, 2.8 and 2.8 for Be, Pb and C respectively.

A second experiment was performed with two large rectangular cloud chambers constructed at Purdue University. The construction and testing for operation at different conditions of these chambers are described. The chambers were operated by counter control for an effective period of four months. Lead and carbon plates were placed inside the chambers to produce and identify the penetrating particles. To follow these particles through a large distance from their origin one chamber was put above the other; this also has provided useful means to observe secondary interactions and to estimate the momentum and mass by the method of Multiple Scattering, the latter being discussed in some details.

The Π ($= p < \beta$) value measured of the shower particles was in most of the cases below 200 Mev. The values of ξ, which is a quantity to separate mesons from protons, have also been obtained. In this way mesons and protons have been identified among the particles forming the showers. The values for the multiplicity of showers produced in carbon and lead are found to be in good agreement with those found in the first experiment. The angular distributions from both experiments show a strong preference in the forward direction.

That the multiplicity and angular distributions are practically the same for both light and heavy elements have been interpreted as an indication of the multiple process involved in the meson production by nucleon-nucleon collisions.

114 pages. $1.43. MicA 55-1151

AN INTERFERENCE EFFECT IN THE ANNIHILATION PROCESS

(Publication No. 11,586)

Gordon Gibson, Ph.D.
University of Pittsburgh, 1955

The two-photon annihilation process is considered in the limit of small velocities for a positron incident on a localized multi-electron system. For brevity, consider a two-electron system. We treat the situation where one electron annihilates with the positron, while the state of the second electron is altered by the removal of the first. The sudden approximation is used for the transition of the surviving electron from its initial to its final state; in order to have interference, neither of the initial electron states can be orthogonal to the surviving electron state. In particular, if the electrons have similar spins, they have symmetric roles in the annihilation process; if they have opposite spins they are distinguishable because of their spins. The positron is treated in the Born Approximation as a free particle, and since the resultant momentum of the photons is fixed for a given final state of the system the momentum of the annihilating electron is fixed through the conservation law. Another condition for interference is that the fourier-transforms of both electron states must be finite for that momentum required of the annihilating electron.

A derivation of the total annihilation rate reveals that the interference effect is zero so that the lifetime of the positron may be determined from the familiar Dirac cross-section for the two-photon annihilation of a single electron and positron if the state of the electrons and the positron is known.

Interference does occur, however, if an analysis of the annihilation process is made as a function of the possible final states of the system. A specification of the final state includes fixing the state of the surviving electron and the angular correlation of the annihilation quanta. The photon momenta are not antiparallel because of the resultant momentum of the annihilating particles. If the state of the surviving electron is not restricted, then interference can occur as a function of the angular correlation of the photons only if the initial one-electron states are not orthogonal. In our picture each electron moves in a field which is modified by some average field caused by the other electrons. Since the Hamiltonian for each electron is different, the one-electron wave functions need not be orthogonal. If the surviving electron state is fixed, then interference occurs in general whether the initial electron states are orthogonal or not.

The interference effect is calculated for positrons annihilating in monatomic and diatomic Li vapor. Two sets of electron wave functions are used for the atomic Li. The interference term which is obtained depends strongly on the choice of the one-electron wave functions, whereas the direct terms vary but not greatly. The magnitude of the interference term depends, of course, on the particular photon momenta which are being considered. The relative magnitude of the interference term to the direct term varies from zero to a maximum of about ten per cent. This is true for positron annihilation in both atomic and molecular Li vapor. 60 pages. $1.00. MicA 55-1152

BETA SPECTRA OF VANADIUM-48 AND RUBIDIUM-86

(Publication No. 11,564)

Lawrence Eugene Killion, Ph.D.
Washington University, 1955

Chairman: Dr. T. A. Pond

A brief review of the essentials of the Fermi theory of beta decay is presented along with an extension to forbidden transitions, spectral shape, and the transformation necessary to restore linearity to F-K plots in the case of the "unique" type spectra. This is followed with a discussion of beta-ray spectroscopy with particular reference to the 180 degree magnetic spectrometer which was used in these experiments. Source technique is discussed in some detail since it

is a critical factor. The methods of data analysis are treated and they outline how the experimental data are customarily compared by means of the F-K plot. The important subject of error analysis in experimental beta decay work is also considered.

A review of the literature on V-48 is followed by a comprehensive description of technique and findings in the experiments herein reported. No evidence is found for the controversial second positron group. An end point of 0.694 ± .006 Mev is obtained for the end point of the well known positron group. An upper limit of 0.1% is set for the relative abundance of a possible positron group decaying to the 0.99 Mev excited state of Titanium-48.

The literature on Rb-86 is also carefully surveyed. The outer beta group is found to have an end point of 1.767 Mev, in good agreement with other recent work. It is further consistent with recently reported investigations of Rb-86 in that it is found to have the "unique" (Δ I = 2, yes) shape since the application of the "unique" shape correction factor results in restoration to linearity of the F-K plot.

The character of the inner group (or groups) of Rb-86 is the point in question. The more fundamental question of the relative errors involved in the conventional subtraction method and the coincidence technique is also involved. The group (or groups) obtained by conventional subtraction exhibits a shape and an end point inconsistent with other reported values. Results of various analyses of the data indicated that the best interpretation was that the inner group was complex. Results of this analysis were consistent with one of the groups being the well known 0.694 Mev beta group. This suggested a region in which to search for a weak gamma ray. Photoelectron spectra gave evidence of a weak gamma ray with an energy of 0.935 Mev in excellent agreement with the prediction. This gives an end point for the new beta group of 0.832 Mev. The well known gamma ray following the 0.684 Mev group was found to have an energy of 1.083 Mev from the photoelectron spectra.

The relative abundance is found to be 80%, 5%, and 15% for the 1.767, 0.832, and 0.684 Mev groups, respectively. The comparative half-lives are calculated for these transitions. On the basis of the results of these experiments with Rb-86, one is inclined to explain the character of the results of the subtraction in Rb-86 by a complexity rather than attributing recently reported serious differences to source thickness and the subtraction process itself.

157 pages. $1.96. MicA 55-1153

CHARGED PHOTOMESON PRODUCTION FROM HYDROGEN

(Publication No. 11,517)

James Elroy Leiss, Ph.D.
University of Illinois, 1955

Charged photomeson production from hydrogen was investigated by irradiating liquid hydrogen with the bremsstrahlung beam from the University of Illinois 300 Mev betatron. Two experiments were performed. In the first experiment charged mesons were counted in a 5 channel range telescope, operating the betatron at maximum photon energies from 140 to 300 Mev in approximately 10 Mev steps. The resulting activation curves were then analyzed for the cross-section using the method of photon differences.[1] The agreement between the cross-section determined by the various counting channels gives assurance that corrections for scattering, absorption and straggling have been satisfactorily made. The cross-section was determined in the region of photon energies from approximately 200 to 300 Mev at center-of-mass angles of 107^0, 149^0 and 165^0.

In the second experiment the total cross-section for photoproduction of π^+ mesons very close to threshold was investigated by stopping the π^+ mesons in a carbon absorber surrounding the hydrogen target. Decay positrons from the resulting μ^+ decay were detected by a counter telescope placed at a large angle to the x-ray beam. The activation curve of these positrons was measured by varying the betatron energy in 2 Mev steps from 140 to 200 Mev. The resulting activation curve was analyzed for the cross-section using the photon difference method. Calculations of the counter efficiency were made using a Monte Carlo method and the University of Illinois digital computer. These calculations are believed to be accurate to better than 10%. From this experiment the total cross-section for π^+ photoproduction has been determined in 2 Mev intervals from threshold to 180 Mev.

The total cross-section, σ_t, from the second experiment is well fitted by

$$\frac{\sigma_t}{4\pi\chi} = [(1.60 \pm 0.1) + (1.20 \pm 0.56)\eta^2] \times 10^{-29} \text{ cm}^2$$

where

$$\chi = \frac{k}{\nu}\left(1 + \frac{\omega}{M}\right)^{-1}(1 + \nu/M)^{-1}$$

where k, ω = meson momentum and energy respectively, ν photon momentum or energy, M = nucleon rest energy, η = meson barycentric momentum $\frac{k}{\mu c}$, where μ is the meson rest mass.

Using the results of both experiments, the cross-section at 90^0 center-of-mass is well fitted from threshold to photon energies of about 250 Mev by

$$\left(\frac{d\sigma}{d\Omega}\right)_{90^0}/\chi = [1.56 \pm .06) + (1.48 \pm .19)\eta^2] \times 10^{-29} \frac{\text{cm}^2}{\text{ster}}$$

This fit is in good agreement with the work of Bernardini and Goldwasser.[2]

Using this fit and a ratio of π^- to π^+ photoproduction cross-sections in deuterium of 1.40 ± 0.1, the values of g, the renormalized symmetric coupling constant, and f, the coupling constant of the Chew cut-off theory,[3] have been determined. These values are: $g^2 = 11.7 \pm 0.7$ and $f^2 = 0.069 \pm .004$. The value of f^2 given by the fit of Chew to meson-proton scattering data is $f^2 = 0.058$.

The angular distributions from the first experiment are in good agreement with those measured in other laboratories.

237 pages. $2.96. MicA 55-1154

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

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ACCURATE DETERMINATION OF MAGNETIC MOMENTS OF EXCITED NUCLEAR STATES: Cd^{111}

(Publication No. 11,673)

Walter Zobel, Ph.D.
Purdue University, 1955

Major Professor: Rolf M. Steffen

The experimental study of the magnetic moments of nuclei has had a strong influence on the formulation of theories designed to account for the static properties of nuclei. These models are, for the most part, a form of independent particle model.

In order to test the validity of these different models a knowledge of the magnetic moment of a nucleus both in its ground state and in one of its excited states would be valuable. It was the purpose of this investigation to determine the magnetic moment of such an excited state with greater accuracy and reliability than was heretofore available.

The method employed is that of influencing the angular correlation of two successively emitted gamma rays by applying an external magnetic field at the radioactive source perpendicular to the plane of the gamma rays. The interaction of this field with the magnetic moment of the nucleus in the intermediate state causes the correlation to become more isotropic. As this change depends upon the magnetic moment it can thus be used to measure it.

Cd^{111} was chosen as the gamma emitter in this investigation because it has a relatively long lifetime of the intermediate state, so that the influence of the interaction would be more pronounced. Further, it is easily obtainable, being the daughter of In^{111} which can be produced in the Purdue cyclotron, and the angular correlation is well known.

It must be remembered that the externally applied magnetic field may not, and usually is not, the only field acting on the nucleus. In particular, interaction of the electric quadrupole moment of the nucleus with inhomogeneous electric fields must be taken into account, and corrections for this effect were made.

A new angular correlation apparatus was designed and built for this experiment. It consists of two fixed detectors, mounted at 90^0 with respect to each other, and a movable detector which can rotate through an arc from 90^0 to 180^0 with respect to the fixed detector. Scintillation counters were used throughout. Coincidences between the signals from the movable detector and each one of the fixed detectors were made separately, so that two correlations can be measured simultaneously. The mechanical equipment was built to operate automatically so that measurement could be continuous. The necessary magnetic field was provided by an electro-magnet mounted so that the field would be perpendicular to the plane of the gamma rays.

The attenuation of the anisotropy of the angular correlation enabled us to determine the product of the absolute value of the magnetic moment of the lowest excited state of Cd^{111} $|\mu|$ and the lifetime of this state τ_N as

$$|\mu|\tau_N = (9.65 \pm 0.25) \times 10^{-8}\mu_N\text{-sec.}$$

Measurement of the lifetime of the excited state by means of delayed coincidences gave a value of τ_N

$$\tau_N = (1.125 \pm 0.043) \times 10^{-7} \text{ sec.}$$

Using the value for τ_N as given above the absolute value of the magnetic moment is found to be

$$|\mu| = (0.87 \pm 0.06)\mu_N$$

The magnetic moment of Cd^{111*} in a $d_{5/2}$ state was compared with the magnetic moments of other odd-neutron nuclei in the $d_{5/2}$ state and found to fit in very well. 77 pages. $1.00. MicA 55-1155

PHYSIOLOGY

A STUDY OF THE MECHANISM FOR CYANIDE RESISTANCE IN TETRAHYMENA PYRIFORMIS

(Publication No. 11,226)

Benjamin William McCashland, Ph.D.
The University of Nebraska, 1955

Adviser: Donald M. Pace

Cells from a clone culture of Tetrahymena pyriformis W were cultured under two conditions: (1) in the absence of potassium cyanide (KCN); (2) in the presence of 10^{-4}M KCN for a prolonged period of time. Cells grown in the presence of cyanide become cyanide-adapted; they are less inhibited by 10^{-3}M KCN in rates of growth and oxygen consumption than are normal cells grown in absence of cyanide. However, the resistance of adapted cells to cyanide is lost if they are cultured in a medium lacking KCN.

Both normal and cyanide-adapted cells contain about 88% water by weight; possess a specific gravity, approximately 1.053; and a lipoidal content, approximately 17% of the dry weight of the cells. Exposure to 10^{-3} M KCN does not alter the ability of either normal or cyanide-adapted cells to store fat.

Cellular volumes were calculated by measurement of cells, packing cells by centrifugation, and calculating nuclear volumes. The average volume of adapted cells is about 88% of that of normal cells. The nuclei are approximately of the same volume. Adapted cells are more resistant than are normal cells to the inhibitory action of 10^{-3}M KCN upon cellular division. However, the increase in size of individual cells previous to cellular division is inhibited to a greater extent in adapted than in normal cells.

Respiration studies, using the direct method of Warburg, show that cyanide-adapted cells are more resistant to the inhibitory action of 10^{-3}M KCN.

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Normal cells may develop some resistance to cyanide if exposed to it for one hour previous to testing. Cyanide-adapted cells contain an intracellular, acid-labile, factor which seems to protect the cells against cyanide. Adapted cells also release a heat-labile material which protects against cyanide. Cadmium chloride (10^{-5}M) inhibits cyanide-adapted cells to a lesser degree during the first one-half hour, but after that the inhibitory effects on both normal and cyanide adapted cells are similar.

By the indirect method of Warburg, the respiratory quotient for normal cells increases to a value considerably above 1.0 in the presence of 10^{-3}M KCN. The R. Q. for cyanide-adapted cells is not greatly altered, although they produce greater amounts of carbon dioxide when exposed to 10^{-3}M KCN than in its absence. Cyanide probably stimulates glycolysis, thus increasing CO_2 production.

Using the Thunberg technique, it was shown that succinic dehydrogenase activity is greater in cyanide-adapted than in normal cells. Cytochrome oxidase activity was determined by the Warburg method, and found to be greater in cyanide-adapted cells.

Riboflavin content in normal and adapted cells was ascertained by microbiological assay, Lactobacillus casei serving as the test organism. Intracellular riboflavin of cyanide-adpated cells is present in an amount almost twice that in normal cells. However, cyanide resistance cannot be induced in normal cells merely by addition of riboflavin, either just previous to a respiration test or during the growth period. The accumulation of riboflavin for cyanide resistance occurs only if the cell is grown in the presence of cyanide.

It is proposed that mechanisms for cyanide resistance in adapted cells are concerned with increased anaerobic glycolysis, an increase in riboflavin-containing compounds for activation of molecular oxygen, and an increased cytochrome oxidase activity which plays a role secondary to the increased activity of riboflavin-containing materials.

107 pages. $1.34. MicA 55-1156

THE MECHANISM OF EARLY AND CHRONIC EXPERIMENTAL RENAL HYPERTENSION IN THE DOG, AS TESTED BY HYDERGINE

(Publication No. 11,856)

Irene H. Oyen, Ph.D.
University of Buffalo, 1955

Hydergine has been used to determine if there is participation of the nervous system in the maintenance of peripheral resistance during the first year of experimental renal hypertension in the dog.

The average blood pressure of ten normal dogs is 139.7/86.5 mm. Hg, and this is reduced 6.9% thirty minutes after intravenous administration of 0.012 mg./kg. of Hydergine. Renal hypertension produced in five of these dogs by moderate constriction of both main renal arteries with Goldblatt clamps increased the average blood pressure during the first year to 196.5/108.0 mm. Hg and Hydergine in these dogs decreased blood pressure approximately to pre-hypertensive control values.

In normal dogs the average value for glomerular filtration rate (creatinine clearance) is 62.0 ± 6.0 ml./min./M^2, for renal plasma flow (PAH clearance), 215.5 ± 34.8 ml./min./M^2 and filtration fraction, 0.297 ± 0.044. Following the administration of 0.20 to 0.012 mg./kg. of Hydergine, the first two are reduced 9.9 and 26.0% respectively, and filtration fraction is increased 25.1%, the effect of the drug being the same at the high and low dose levels but most of the work being done with the latter to avoid toxic side reactions.

In the experimental renal hypertension there is no significant change in renal excretory function, nor any tendency for clearances to change as hypertension is prolonged up to 55 weeks, glomerular filtration rate being 65.5 ± 7.9 ml./min./M^2, renal plasma flow, 220.9 ± 27.9 ml./min./M^2 and filtration fraction 0.305 ± 0.059 as grand averages for this 55 week period. Hydergine decreases glomerular filtration rate and renal plasma flow 8.4 and 25.6% respectively, and increases filtration fraction 22.6%.

However, closer scrutiny reveals that during the first 10 weeks of hypertension Hydergine decreases filtration rate and plasma flow more markedly than in normal dogs, viz., 13.7 and 30.6% respectively; also, these decreases become smaller with time so that at about six months, the hypertensives react as normals; still later, toward the end of the 55-week period, Hydergine has still less effect, no longer reducing filtration rate or plasma flow significantly. This suggestion of a decreasing effect of Hydergine on renal hemodynamics with prolongation of hypertension is confirmed by regression lines of filtration rate and plasma flow changes against time, the slopes of these lines being positive and significant.

The hypotensive effect of Hydergine is due to central inhibition of vasomotor tone, centrally induced bradycardia and peripheral sympathetic blockade; its renal hemodynamic effect is due to a decrease in filtration (arterial) pressure and an increase in resistance to flow (renal vasoconstriction) due to reflex or autonomous adjustment of the caliber of the renal vessels in response to the lowered arterial pressure. The trend toward a decreasing effect of Hydergine on renal flow of hypertensive dogs with time is interpreted to mean that the centrally and peripherally induced vasodilation which decreases blood pressure and which is overcome by compensatory vasoconstriction in normal and early hypertensive dogs, is gradually extended to include the renal vessels. It is concluded that with increasing duration of hypertension there is a gradual increase in tone of the vasomotor center and/or an increase in peripheral sympathetic tone. Therefore, in chronic experimental renal hypertension in the dog, the elevated peripheral resistance is maintained in part by increased sympathetic activity.

The dissertation reviews extensively the literature on experimental hypertension, the ergot alkaloids and nervous influences on renal function.

321 pages. $4.01. MicA 55-1157

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STUDIES IN CALCIUM DEPOSITION AND EXCHANGE IN VENUS MERCENARIA

(Publication No. 11,604)

Thomas Ferguson Redick, Ph.D.
University of Pittsburgh, 1955

The problems dealt with in the present investigation concerned the deposition and exchange of calcium in the common hard shell clam Venus mercenaria. Ca^{45} was used as a tool in attempting to answer the following questions: (1) On what area of the shell of Venus mercenaria would Ca^{45} deposition occur? (2) Would the deposited area of Ca^{45} stay fixed for a sufficient time to be used as a reference for measuring shell growth? (3) Is calcium reabsorbed from the shell into the mantle cavity fluid when Venus mercenaria is kept out of water over a period of days? and (4) Is calcium exchanged between the mantle cavity fluid and the blood?

The experimental clams were immersed for 72 hours periodically in sea water containing Ca^{45} as $CaCl_2$. The total activity of the sea water was 13 microcuries per liter. After each period of immersion four clams were sacrificed and cross sections were cut from the shells. Autographs were made from these cross sections on X-ray film.

Following the periodic Ca^{45} treatment the clams were left in sea water from 45 to 77 days. The Ca^{45} was retained as follows: (1) Sixteen clams had relatively continuous layers of Ca^{45} along both the inner and outer surfaces of the shell. (2) Twenty shells had one or more areas in which Ca^{45} was unusually high; 14 of these 20 had the darker areas representing the Ca^{45} at or near the ventral portion of the inner layer of the shell. (3) Five clams retained Ca^{45} to a greater depth in the nacreous layer. The clams did not hold Ca^{45} over a four-month period. Dead shells did absorb Ca^{45} from sea water but failed to hold it for the two-month period as the living shells did.

Another group of Venus mercenaria were immersed in sea water containing Ca^{45} as $CaCl_2$, 26 microcuries per liter. The clams were washed in running non-radioactive sea water and stored in air at 8-10°C. Periodic counting showed that the Ca^{45} was taken up by the shell and reabsorbed by the mantle cavity fluid and blood. The concentration of Ca^{45} in the mantle cavity and blood was about the same over a 32-day period. 34 pages. $1.00. MicA 55-1158

EXTRA MEDULLARY FACTORS AFFECTING BREATHING IN NORMAL AND VAGOTOMIZED BIRDS

(Publication No. 11,667)

Fred Walter Stemler, Ph.D.
Purdue University, 1955

Major Professor: William A. Hiestand

An investigation was undertaken to ascertain what influence removal of higher brain areas might have on the breathing movements in normal and vagotomized fowl. Transverse lesions were placed in the brainstem of decerebrated and non-decerebrated fowl after vagotomy to facilitate correlation in the rate of breathing movements with the sites of lesions. A change in the rate of breathing movements was taken as an indication of different mechanisms controlling respiratory movements.

Most of the operations were performed upon young and adult fowl under Nembutal anesthesia. Ether was also used alone or in combination with Nembutal or urethane whenever necessary. An accordion-type pneumograph was connected to an ink writing tambour for the recording of breathing movements on a revolving kymograph drum.

Surgical procedures followed on fowl consisted of a ventral and dorsal approach for vagal isolation and sectioning, removal of the cerebral hemispheres and partial decerebellation.

Five decerebrated fowl were kept alive on a milk diet for periods ranging from $1\frac{1}{2}$ to 5 months. The decerebrated fowl were essentially able to maintain their normal body temperature when exposed to low environmental temperature for several hours. They responded to high external temperature by panting.

A decrease in the respiratory rate occurred after vagotomy in normal, panting, or decerebrated fowl regardless of the approach used for vagal isolation. The decrease in respiratory rate was not due to mechanical interference in the trachea, low body temperature or anesthesia, but was apparently a nervous phenomena.

An increase in the rate of breathing occurred in vagotomized fowl when transverse lesions were produced in the brainstem of fowl which were non-decerebrated, decerebrated or partially decerebellated. The slow, deep, labored breathing of these birds was replaced with a less distressing, more rapid, and shallow type of breathing. Brainstem lesions resulted in uncontrollable bleeding and immediate death of some fowl, inasmuch as blood vessels to the head were not clamped or ligated in any of these experiments. However, many of the fowl lived for variable periods of time, from several minutes to several hours after the lesions were produced.

The brain of each fowl was examined macroscopically in an effort to establish the sites of lesions in the brainstem. The lesions were in an area located approximately between the middle and the posterior edge of the optic lobe. The lesions cover such a wide area that it is difficult to localize the nerve fibers or centers responsible for the rapid breathing seen in vagotomized fowl with midbrain lesions.

107 pages. $1.34. MicA 55-1159

POLITICAL SCIENCE, GENERAL

THE VIRGINIA VESTRY: A STUDY IN THE DECLINE OF A RULING CLASS

(Publication No. 10,987)

James Kimbrough Owen, Ph.D.
Princeton University, 1947

This dissertation represents an attempt to define the Virginia vestry at the peak of its development, the opening decade of the eighteenth century, and to analyze the reasons for its decline and fall at the end of that century. The Virginia vestry was the governing body of the parish, a unit of local government vested with certain political as well as ecclesiastical functions. At the beginning of the eighteenth century the vestries enjoyed a considerable degree of independence from the central authorities of the colony, and through the development of cooption they enjoyed also an immunity from popular control. Acting then in response to a sense of public responsibility rather than from any effective means of accountability, the vestries engaged actively in the construction of churches, in the hiring of ministers, in processioning, in publication of official news, and in the care of the poor. Even in fields where they were given little or no statutory responsibility such as roads, ferries, and education, they indicated a willingness to assume the initiative in solving local problems on a local level. In their relations with the royal governors, the vestries revolutionized the English pattern for control of the clergy by substituting a form of business agreement for the presentation and induction formula of England. In doing this, the vestries formed precedents for a type of home rule freedom of local units from central control. The strength of the vestries depended upon their sense of political responsibility. After the first quarter of the eighteenth century, it began noticeably to decline, yet because of the stalemates between the Council and the House of Burgesses, they continued to be free from external control. With the assistance of such techniques of control as the extended parish, the complementary election, and the self-contained parish, the conservative forces of the colony extended the vestry system to the expanding Virginia frontier. Their success was indicated by the fact that the frontier did not produce a democratic vestry. The vestry system was also successfully imposed upon non-Anglican groups because the conservatives were clever enough to allow the leaders of these communities to become the vestrymen.

The Great Awakening in Virginia of the 1750's, that period of fervent religious revival, was facilitated by the now decadent vestries, and at the same time it effected a split both in the leadership and the following of the vestries. The Presbyterians made great inroads among the vestry class and the Baptists made even larger inroads among the vestry following. The public press not only absorbed one of the important parish functions, that of publication, but also served as a means for undermining the vestry system, both by attacking specific vestries and by contributing to a public opinion opposed to the established church. The identification of the vestry system with some of the most unpopular aspects of British rule contributed to its final overthrow. Taxation without representation had become an issue in local government in Virginia before the era of the stamp acts. The deflection of some of the clergy of the established church during the Revolution was given wide publicity. It seems remarkable that the vestries survived for almost a decade after the outbreak of the Revolution.

The final disintegration of the vestries was due first to the actual breakdown of individual vestries in the eastern part of the state and the consequent necessity of making some provision for the performance of their functions, particularly poor relief; second, to the fact that the unpopularity of the vestry system led to the use of the overseer of the poor in the new western counties. In 1784 the vestries were deprived of all political functions and in 1786 overseers of the poor were provided for the whole state to replace them.

The substitution of overseers of the poor for the vestry system represented a real loss to Virginia, for the parish had demonstrated its ability to afford healthy opportunities for rural democracy, for the settlement of local problems on a local level, and for the resistance of local units to central control. It was Virginia's misfortune that the vestries were not returned to the people rather than abolished.

306 pages. $3.83. MicA 55-1160

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

PROLOGUE TO ANNIHILATION: A STUDY OF THE IDENTIFICATION, IMPOVERISHMENT, AND ISOLATION OF THE JEWISH VICTIMS OF NAZI POLICY

(Publication No. 11,457)

Raul Hilberg, Ph.D.
Columbia University, 1955

The destruction of the European Jews was a process of the utmost administrative and psychological complexity. In 1933, the Jewish community in Europe

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was a highly urbanized, highly developed population which was integrated almost completely into the political, economic, and social life of the continent. The Nazi machine of destruction succeeded to uproot the Jews in a step by step process which ended with the physical annihilation of the victims. The "Prologue to Annihilation" deals with the introductory phase of this destruction process.

The Germans did not have a basic plan, but their actions fell into a basic pattern. No group of people can be killed before measures are taken to isolate them and their property, and no concentration measures will be effective before the perpetrator knows which group precisely is to be destroyed.

The German definition of the term "Jew" was based on the descent of the prospective victim. Everyone was considered a Jew, if he had three or four Jewish grandparents who had belonged to the Jewish religion. A person with only two Jewish grandparents was classified as Jewish, if he was a Jew or if he was married to a Jewish person at the time of the issuance of the decree. Under this definition, a victim was powerless to escape from the application of hostile Nazi measures.

Once it had become clear who was liable to suffer anti-Jewish action, the bureaucracy could proceed with the systematic expropriation of the Jewish property. The expropriatory operation began with the dismissals of Jewish employees. It continued with the "aryanization" of Jewish enterprises. "Aryanization" meant the transfer of a Jewish business into non-Jewish hands. Before November 1938, the Jews were not forced to sell their holdings, but after 1938 all transactions were carried out in a compulsory process by "trustees" responsible to the State alone. Since the "aryanizations" placed large amounts of credits into Jewish hands, the Finance Ministry decided to levy two major property taxes upon the Jews: an emigration tax and a billion Reichsmark "fine." Most other Jewish assets were later blocked. The Jews were forced into hard menial labor, their wages were decreased, and their earnings were subjected to a special tax.

The third step of the destruction process, concentration, was carried out in the Reich by marking the Jews with a star and by restricting their movements. In Poland, the victims were crowded into medieval-like ghettos which were closed off from the outside world. Food shipments to the ghettos were gradually decreased to the starvation point. Survival in the ghettos became more and more difficult. At the end of 1941, the Polish ghetto Jews were dying at the rate of about 1.5% per month. At this rate, they faced extinction within a generation. However, the German bureacracy could not wait that long. They had to "solve the Jewish problem" right then and there. Accordingly, in the summer of 1941, massive killing operations were launched against European Jewry.

The annihilation phase of the anti-Jewish destruction process – which includes killing operations conducted by mobile SS and Police units in the occupied USSR as well as deportations to gassing centers in the rest of Axis Europe – is a story which is described in another fifteen hundred pages that were not included in the "Prologue." It is hoped that some day the entire work will be available to readers in the form of a book.

416 pages. $5.20. Mic 55-114

POLITICAL SCIENCE, PUBLIC ADMINISTRATION

FEDERAL AID FOR PRIMARY AND SECONDARY EDUCATION

(Publication No. 10,971)

William Alexander Mitchell, Ph.D.
Princeton University, 1948

From the very beginning, the Federal Government has indicated great interest in education. Even before the adoption of the Constitution, the Ordinances of 1785 and 1787 established a policy of disposing of the public domain for the encouragement of education. In this way, prior to 1862, the Federal Government aided general education as distinguished from special education such as agricultural or vocational training. However, in 1862, Congress passed the First Morrill Act endowing land grant colleges "for the benefit of agriculture and the mechanic arts." With the Morrill Act, the Federal Government changed its fundamental policy on education to one of encouraging the advancement and development of specialized types of educational activity. The Hatch Act passed in 1887 provided grants for agricultural experiment stations, the Smith-Lever Act of 1914 established the cooperative agricultural extension service and the Smith-Hughes Act of 1917 provided support to vocational education. The Federal Government is now engaging in educational activities of a specialized character on a wide front.

Although the school system in the Western States was considerably strengthened by the Federal Government's policy of specifying that part of the public domain be used for educational activities, it now has no permanent program of helping general education in the primary and secondary schools. This does not mean, however, that there have been no attempts to secure Federal aid for the school system. After the Civil War there were many proposals for Federal aid to the states for primary and secondary education. At the time many Northern states had a serious problem of educating great numbers of immigrants, and the Southern states were developing a public school system for the white people and for the emancipated Negroes. A bill introduced in 1872 passed the House of Representatives. In 1880, the Senate passed a proposal introduced by Morrill, who sponsored the land grant college bill. Throughout the 1880's, bills introduced by Senator Blair were under discussion. The Senate passed legislation for Federal support of the school system three times, in 1884, 1886, and in 1888. Following the defeat of the Blair bill in the Senate in 1890, it was not until after the First World

War that there was further agitation for Federal aid for education. Since then there has been great interest in the passage of such legislation and the effect which it would have.

A number of factors have contributed to the failure to secure the passage of legislation for Federal aid to education. The inability to reach a solution of the controversy as to the use of Federal funds for parochial schools has been of importance in this respect. Catholic spokesmen have opposed all proposals which did not provide Federal aid for parochial schools even though it be against the policy of the state to use public funds for non-public schools. The effect which Federal aid to education would have upon the segregated school system of the South has also produced various reactions which have increased the difficulties of securing passage. Most of the proposals have contained some scheme to insure that the colored schools of the South receive an equitable apportionment of funds. On occasions, however, it has been difficult and sometimes impossible to reconcile forces which have differing interpretations of "equitability." Failure to secure agreement on the formula for allocating funds to the various states has a large role in the story of Federal aid. The formula may be based on some type of population ratio or some element indicating need or a combination of both. Factors of constitutionality, administrative arrangements to secure compliance by the states with the terms of the legislation, the emotional climate in which debate and discussion took place particularly after the Civil War, and the attitudes of the major political parties and their leaders have borne upon the outcome.

Various organizations and groups have held definite and frequently conflicting opinions on the subject of aid. Generally labor groups have favored Federal aid, and the various management groups and organizations have been opposed. The teachers' organizations have frequently been in disagreement on the proposed provisions of legislation. The Negro groups have advocated aid under certain conditions. The Catholic and Protestant Churches have brought their pressure to bear particularly on the matter of aid for non-public schools.

One of the basic issues has been the question of whether Federal aid means Federal control. Many types of controls have been contained in the legislation proposed over the years. Some of the bills would have meant considerable Federal control, and others would have provided for a minimum of control. Nothing has been more crucial to the advocates of Federal aid than to establish the fact that it does not mean unwarranted Federal intervention in an activity traditionally regarded as a state-local matter.

The inability to solve the dilemmas and the failure of the organizations and groups interested in Federal aid to agree on the proposal which they desire, has prevented the passage of legislation for which there has been general support for almost seventy years. Whether Federal aid for general primary and secondary education becomes an actuality depends in large measure upon the avoidance of the pitfalls which have trapped the advocates in the past.

484 pages. $6.05. MicA 55-1161

FINANCIAL ASPECTS OF STATE MONOPOLY AND STATE LICENSING OF ALCOHOLIC BEVERAGES, WITH SPECIAL REFERENCE TO THE COMMONWEALTH OF PENNSYLVANIA AND THE STATE OF NEW YORK

(Publication No. 11,430)

Martin Roth Ream, Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. Alfred G. Buehler

Shifting social and technological considerations have necessitated frequent re-interpretations of the objects of regulation and taxation of alcoholic beverages. Experience has undoubtedly been the best teacher. Under these conditions, methods of control and taxation vary greatly among the several states. Each state has worked out its own system of control and taxation based on public attitudes and theories regarding the merits of the various methods. There are, however, many fundamental problems common to all states which necessitate effective and efficient cooperation among the various state agencies dealing with alcoholic beverages. In addition, the activities of both the federal and state governments in the field of alcoholic beverage control and taxation must be coordinated for effective results.

For a better understanding of present day problems of control and taxation, a thorough knowledge of changes in organizational methods, techniques and procedures concerning alcohol beverages is necessary. The liquor industry throughout the years has been subjected to regulation, careful supervision and various forms of taxation. This control was necessary from the revenue and social aspects. From provincial times, the illicit production of liquor has been a source of tax evasion and constitutes a detrimental influence on social objectives. Prior to the latter part of the nineteenth century, policies of most state legislatures regarding liquor control and taxation embraced the principle of local administration of the liquor acts. Gradually, the tendency toward centralization became apparent in the administration of the alcohol beverage laws. Excise taxation, imposed from early provincial times as a major source of revenue, was replaced by the license system. With the failure of the license system to curb the growth of anti-social procedures in the liquor industry, especially the saloon type of retail establishment, national prohibition resulted.

National prohibition can be partially attributed to the vacillating policies adopted by the states in regard to liquor legislation. The Eighteenth Amendment did not represent an abrupt break with previous control legislation. On the contrary, national prohibition climaxed a long history of temperance reform. However, public apathy and opposition to national prohibition increased as time passed and made effective enforcement practically impossible. Moreover, the federal and state governments were keenly aware of the revenue possibilities inherent in the legalization of the alcohol beverage industry. Declining tax revenues and mounting state deficits accentuated this phase.

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With the advent of Repeal, control was vested in the states by the terms of the Twenty-first amendment. This pattern of control and taxation differed widely. However, two methods of approach were employed, namely the monopoly system for the sale of distilled spirits and the license method combined with excise taxation. In comparing these diverse methods cognizance was taken of (1) legislative and administrative regulatory devices; (2) legal requirements and administrative procedures in regard to taxation; (3) revenue and apparent consumption analyses.

Furthermore, revenue and apparent consumption data, including per capita ratios and averages for distilled spirits, wines and malt beverages, the analyses of the number and types of licenses, and the study of the various types of establishments dispensing alcoholic beverages are not, in themselves, conclusive as to the merits of the monopoly or license systems. However, these factors do show definite trends which are discernible with respect to (1) the promotion of temperance through moderate consumption, (2) increased revenue to the state, (3) and social considerations through effective administration.

590 pages. $7.38. Mic 55-115

STATE LEGISLATION RELATING TO STANDARDS DEVELOPMENT IN BUILDING REGULATION

(Publication No. 11,880)

John Howard Vanderzell, Ph.D.
Syracuse University, 1955

The central problem of modern democracy is the invention of systems which admit the right and necessity of spontaneous development and which effectively find the norms forming the base of regulations without suppression. In the American democracy this problem is compounded by a three tier organization of governments – federal, state and local – and the allocation of discretionary power to administrators, legislatures and courts at all three levels. The focus of this study is on state statutes which describe and prescribe the regulatory systems in the field of residential building.

Within the same state and among the states different systems are established to regulate the same or different aspects of building and housing. This is true in terms of the location of the standard writing function, – it may or may not be in the legislature – in terms of application of the standard in enforcement processes, and in terms of the location of a power to define the meaning of the standard.

The usual presumption is that standards will be promulgated by a legislative or administrative body before any enforcement is attempted. But, there is an intermediate position which allows an enforcement officer to define the specific standard under a broad statutory grant. An example is the grant of authority to some officer to order the repair or demolition of "unsafe," "dilapidated," or "unsightly" buildings. The role of the courts must be more central in such a system, providing nothing more, than in a system of prior legislative or administrative code writing.

Another alternative to the formal establishment of standards by the legislature or administrative agency is the use of reference adoption procedure. Some state legislatures adopt the codes of private groups or delegate power to administrative officers or local governments to adopt such codes by reference. A serious question of constitutionality is raised when the adoptive statute attempts to give legal sanction to any subsequent amendments which the private group may make to the existing adopted code.

Some attempts have been made to devise systems which formally unite the code writing and enforcement processes. Notable are delegations to licensing agencies of substantive rule making power and the use of performance codes. This union is accomplished to some extent by administrative review processes too, but probably to a lesser extent in the field of building and housing than in some other areas of regulation.

These regulatory patterns ideally attempt to reach an acceptable composite of expert understandings and popular notions of fairness. But a major problem is the establishment of uniform standards while retaining the established systems of local responsibility. With but two exceptions the compromise arrived at in every state is the creation of a minimum standard which local governments, in their wisdom, may exceed.

A comprehensive recital of techniques used to integrate or isolate state and local operations and unite expertness and fairness could only result in an extensive monograph. But present techniques must be studied with a view to inventing systems incorporating the capacities and virtues of local and state and federal governments which recognize the role of the expert conditioned by other values deserving of recognition in a free society.

286 pages. $3.58. MicA 55-1162

PSYCHOLOGY, GENERAL

HIGHER LEVELS OF MANAGEMENT AND EMPLOYEE ATTITUDE TOWARD THE FOREMAN

(Publication No. 11,622)

Richard Donald Draper, Ph.D.
Purdue University, 1955

Major Professor: Dr. C. H. Lawshe

The present study is an exploratory investigation in industrial psychology. The purpose of the study was to isolate the effect higher levels of management have on the attitudes of employees toward their foreman.

An Employee Opinion Survey was developed in conjunction with a midwestern farm tractor manufacturer to be used with plant non-managerial employees. The questionnaire contained forty-nine questions covering various phases of the work environment. Fifteen questions measured employee attitude toward the foreman. The survey was administered to 1345 employees, the results were analyzed, individual reports were prepared for foremen, general foremen, and superintendents, and action was taken based on the results of the survey.

To test the hypothesis that higher levels of management influence employee attitude toward the foreman, a single classification analysis of variance design was employed, with superintendents designated as treatments and employee attitude toward the foreman as the measured variable. The effects on employee attitude of the extraneous variables: union membership, day vs. night work, type of work performed, daywork vs. piecework, and work pacing were investigated and, where necessary, controlled.

It was found in the present investigation that dayworkers did not differ in attitude from pieceworkers, and that work pacing was only slightly related to attitude. The effect of work type could not be satisfactorily investigated due to statistical confounding with other factors. Therefore, it was necessary to employ a sample for the central analysis which contained employees all of whom were performing essentially the same kind of work. Two previous studies had shown that day or night work did not influence employee attitude, but that union membership did. The sample for the central analysis, therefore, included employees belonging to only one union.

In the central analysis a difference among superintendent groups in employee attitude toward the foreman was found significant at the 5% level of significance. This clearly suggests, although it does not show conclusively, that the superintendent has an influence on his employees' attitudes toward their foremen. 47 pages. $1.00. MicA 55-1163

THE RELATION OF PRE AND POST-RETIREMENT INFORMATION TO POST-RETIREMENT ADJUSTMENT

(Publication No. 11,623)

Lawrence Marquette Eger, Ph.D.
Purdue University, 1955

Major Professor: H. H. Remmers

An exploratory study of variables thought to be related to adjustment to retirement was undertaken by administering the adjustment measuring instrument, Your Attitudes, to a sample of retired employees of a steel manufacturer. Most of the variables investigated were in the personnel records of the steel manufacturer, including interview data expressing attitudes of the employee about retirement at the time he became eligible to retire from his job. An item analysis of the attitudes and work history facts against adjustment scores indicates that those who shortly before retiring said their health was adequate for their regular job did not adjust to retirement as well as those who had said their health was not adequate for their regular job. Income and number of dependents shortly before retiring are positively related to adjustment to retirement. Those owning a home shortly before retiring adjusted to retirement better than those who did not own a home. Those who made plans for retirement before retiring adjusted better than those who did not make plans. Amount of monthly income during retirement is positively related to adjustment to retirement.

96 pages. $1.20. MicA 55-1164

RECOGNITION THRESHOLDS FOR FREUDIAN SYMBOLS AND RELATED PHENOMENA

(Publication No. 11,505)

Malcolm LeGrande Gardner, Ph.D.
University of Illinois, 1955

This experiment was designed to study the effect of Freudian "universal" symbols on recognition thresholds. The theories of Sigmund Freud on symbolism were translated into terms of current perceptual theory, primarily those theories posited by Jerome S. Bruner, Leo Postman, and their associates. Freud claims that symbols serve to protect the organism from recognition of the objects or the ideas for which the symbol is a plastic representation. The ideas involved, and the meaning of the symbol, are kept unconscious by means of the mechanism of "repression." Such "repression" should be exemplified perceptually by a performance such as that termed "perceptual defense" by Bruner, Postman, et. al.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

It was hypothesized that the activation of specific symbol associations, claimed by Freud to be "universally" available in the culture, would produce a longer recognition time to the tachistoscopically presented symbols, than would occur to similarly presented non-symbols.

The design employed to test this hypothesis was a 2 x 2 x 2 x 2 analysis of variance design. Stimuli were drawings and words judged by a group of clinically trained judges as either symbol or non-symbol drawings, 'charged' or 'neutral' words and "associated' or 'unassociated' pairings between drawing and word. Primary interest centered on the symbol-non-symbol dimension, however, questions that might be raised from the experimental literature on perception, or as a result of the procedure employed, necessitated the addition of the other three dimensions as controls.

Since the words associated with Freudian symbols are considered emotionally 'charged,' a control group of words judged 'neutral' in affective value were employed. In view of the association existing between the Freudian symbol and the idea symbolized, it was necessary to use control groups in which no such ready association was to be found between the drawing and the word presented with it. And, finally, since appropriate subjects could not be obtained from a single source in the numbers desired, a comparison between the two populations used was necessary. Thus, the four dimensions of the design were: (1) symbol vs. non-symbol drawings, (2) charged vs. neutral words, (3) associated vs. unassociated relationship between the drawing and the paired word, (4) Physical Education students vs. Air Force personnel.

Subjects were 48 Physical Education majors in the University of Illinois, and 32 Airmen from Chanute Air Force Base, Rantoul, Illinois. The procedure involved two phases. In the initial phase the subject, randomly assigned to one of the eight experimental conditions, was presented the appropriate drawing-word pairs for his condition. The drawing alone was presented tachistoscopically for one second and immediately followed by the drawing paired with its appropriate word for one second. The subject was asked to verbalize the word each time a drawing-and-word pair was presented. In the second phase the drawings only were presented tachistoscopically for recognition time. The recognition time in milliseconds was recorded as the dependent variable.

The results of the analysis of variance were inconclusive in that the F-ratios obtained were such that the entire analysis was suspect. Attempts to account for the anomalous results yielded no definite conclusions, though several possibilities were offered. An inspection of the means suggested differences between the symbol and non-symbol drawings as a result of association, and differences between populations, but those are subject to question in view of the difficulties cited with the analysis. Some inferences were drawn for future research.

96 pages. $1.20. MicA 55-1165

STABILITY IN RESISTANCE TO FIELD FORCES

(Publication No. 11,633)

Douglas N. Jackson, Jr., Ph.D.
Purdue University, 1955

Major Professor: E. J. Asher and John M. Hadley

To test the hypothesis that there is intra-individual consistency in reaction to field forces, whether these forces are perceptual, social, or at other levels, a correlational design is used. The variables are: four perceptual measures: the embedded figures, words in masking noise, ability to hold in perspective one aspect of a reversible cube and a reversible cross; a situation in which the subject is instructed to refrain from blinking his eyes; the California Authoritarian Scale with some items reversed, others in their original form; the Purdue Physical Science Aptitude Test, a measure of conformity in judgment; and a specially devised sentence completion test designed to measure interpersonal passivity. A measure of intelligence is also included as a control. The sample is composed of 19 men and 31 women.

Although the tasks vary widely in structure, their theoretical similarity is suggested by the fact that they all require the subject to overcome hypothetical field forces. The dimension of perceptual offense, the general level of activity which a subject brings to bear on a task involving perceptual or cognitive field forces, is offered. The ability to keep figures separate from ground, to resist the forces which cause figure and ground to merge is considered a special case of the perceptual offense dimension. It is hypothesized that this ability will manifest itself not only in visual situations, but in auditory perception and in the perception of the self as figure in relation to the context group. Thus, the theoretical similarity between the perceptual tasks and those tapping the extent of ego-environment polarity is indicated.

The men's results yielded support for the general hypothesis, but the null hypothesis cannot be rejected for the women's results. For the men, the perceptual index, based on the standard scores of the four perceptual variables, yields correlations significant at the one per cent point with the passivity and conformity measures. The failure of these relationships to appear for the women is attributed to the low reliability of their conformity and passivity scores and to the lower level of consistency in college women due to a conflict in anticipated roles.

Thus, within certain limits the hypothesis that there is self-consistency in susceptibility to field forces at different levels is tenable for the men. Further research is necessary to appraise this hypothesis for the women, as the results are inconclusive in the present study.

Although the important relationships can not be attributed mainly to intelligence, an important finding is that the embedded figures correlates significantly for both sexes with the measure of intelligence. The lack of independence of Physical Science Aptitude from intelligence prevents interpretation of that

variable. The data from the California F-scale is not subjected to statistical test due to unforeseen complications arising from the necessity for subdividing the data according to sex and the different forms used. The controlled blink rate is highly related to conformity for the present sample of men, but, despite other suggestive relationships, must await further confirmation before it can be concluded that it is a good measure of the dimension in question.

It is suggested that further research be undertaken to more fully develop the present measures, to determine the origins of some of the observed relationships in development, and to apply the general approach to specific theoretical and applied problems.

It is concluded that the general method of studying a group of subjects intensively with a fairly substantial number of measures is fruitful, especially in exploratory work. This study is an addition to the growing body of research which attests to the value of the study of motivation through perception.

127 pages. $1.59. MicA 55-1166

A COMPARATIVE STUDY OF THE EFFECTS OF INDIVIDUAL AND GROUP WAGE INCENTIVE PLANS UPON PRODUCTIVITY AND INTERPERSONAL RELATIONS

(Publication No. 11,596)

Leonard Learner, Ph.D.
University of Pittsburgh, 1955

This paper describes two experimental studies, one conducted at Western Penitentiary, the other at Goodwill Industries, which had as their purpose the investigation of the comparative effects of individual and group wage incentive plans upon productivity and interpersonal relations. In Western Penitentiary 74 male prison inmates, manufacturing license plates, served as subjects in two experimental groups and one control group. In Goodwill Industries 42 handicapped workers (both male and female), repairers of donated clothes and household furnishings, made up two experimental and two control groups. In both Western Penitentiary and Goodwill Industries workers in one experimental group were alternated from an individual to a group and back to an individual incentive system of wage payment, while the other experimental group was alternated from a group to an individual and back to a group incentive system of wage payment. The control groups were paid a straight time wage. Under the individual incentive system each worker was paid according to the number of units he alone produced. Under the group incentive each worker's pay was based upon the number of units produced by the group to which he belonged. Records of production were kept by a clerical assistant to the supervisor at Western Penitentiary and by department supervisors at Goodwill Industries. Performance Records of effective and ineffective critical worker behaviors, of an interpersonal relations nature, were recorded by supervisors in both industries. A specially-constructed Attitude Survey Questionnaire, which provided information pertaining to interpersonal relations and worker attitudes toward different wage payment systems, was filled out by all subjects prior to each change in system of wage payment and again at the close of the study.

The critical ratio statistical technique was used in the treatment of productivity data and in the analysis of interpersonal relations data derived from the Attitude Survey Questionnaire. The chi square statistical technique was employed in the treatment of Performance Record data and in the analysis of workers' expressed attitudes toward the different systems of wage payment.

In comparing the individual versus the group incentive plan the results of both studies were in essential agreement. It was concluded that:

1. There was no difference between individual and group wage incentive plans in their effects upon productivity.
2. In all instances but one, there was no difference between individual and group wage incentive plans in their effects upon interpersonal relations as measured by both the Attitude Survey Questionnaire and the Performance Record. In the one isolated case interpersonal relations were better under the group incentive.
3. In all groups but one, worker attitudes toward the different wage payment systems did not change. In the exceptional group, attitudes toward the group incentive plan became more favorable after these workers had worked under the group incentive plan.

The implications of these findings for management personnel are that practical considerations, such as ease and cost of installation and maintenance, and worker and/or supervisor preference, should govern the choice between the two financial incentive systems. Although the populations studied differed somewhat from the normal industrial population, they resembled it closely in many other respects, making findings generalizable, but with caution.

114 pages. $1.43. MicA 55-1167

AN INVESTIGATION OF HYPOTHESES BASIC TO A CONCEPT OF RELATIVE INTENSITY OF INTERACTION

(Publication No. 11,639)

David B. Lynn, Ph.D.
Purdue University, 1955

Major Professor: Franklin J. Shaw

The purpose of this study is to test two hypotheses basic to a concept of relative intensity of interaction. In general, the concept of relative intensity of interaction proposes that the intensity in the response of one individual be measured by how much it differs from the intensity of other individuals' responses when the intensity in the behavior eliciting these responses is held constant.

Before presenting the two hypotheses, several terms are briefly defined below:

The Structured Doll Play Test is a projective test for children in which family dolls are presented in conflict situations and the child resolves these conflicts by play.

By "child (mother) doll response" is meant behavior directed toward the mother (child) which the subject projects onto the child (mother) doll.

By "absolute intensity" of a response is meant its judged position on an affection-aggression continuum without regard for its provocation. By provocation is meant the behavior of the other doll immediately preceding the response in question.

The two hypotheses tested in this study are as follows:

1. The absolute intensity of child doll responses should be moderately correlated with the absolute intensity of the preceding mother doll responses eliciting them in the Structured Doll Play Test protocols.
2. The mother doll responses should be similarly correlated with the preceding child doll responses.

If these two mother-child doll interaction hypothesis are supported, a measure of relative intensity of interaction should be feasible. The predicted moderate correlations imply that mother (child) doll responses of the same absolute intensity elicit child (mother) doll responses which tend to be similar to each other in absolute intensity. It further implies that the intensity of responses elicited tends to vary with the intensity of the responses eliciting them. A measure of relative intensity of a response would be a measure of the degree with which the intensity of each response deviates from these trends.

Perfect correlations would indicate that when the mother (child) doll responses are at a given intensity on the affection-aggression continuum, the child (mother) doll responses are all at exactly the same intensity. With perfect correlations, it would be impossible to measure relative intensity of interaction because there would be no deviations among responses elicited by other responses, held constant for intensity, on which to base a relative measure.

Zero correlations would imply that the intensity of the mother (child) doll responses shows no lawful tendency to vary concomitantly with the intensity of the child (mother) doll responses. Thus, the concept of relative intensity of interaction which assumes a lawful trend from which to measure its deviations, would be devoid of meaning in distributions of extremely low or extremely high correlations.

The hypotheses were tested in responses obtained by administering the Structured Doll Play Test to 34 clinic children, ranging in age from six years to ten years two months. The correlations obtained are such that a measure of relative intensity of interaction seemed feasible with Structured Doll Play Test responses.

The two mother-child doll interaction hypotheses were supported with correlation ratios (7) of .54 and .51 respectively and Pearson product-moment correlation coefficients (r) of +.47 and +.48 respectively.

The operational definition of relative intensity of interaction is as follows: The relative intensity of child (mother) doll response A (preceded in the protocol by mother (child) doll response B) is assigned by the number of scale units it deviates above or below the mean absolute intensity of all child (mother) doll responses elicited by preceding mother (child) doll responses of the same absolute intensity as B.

141 pages. $1.76. MicA 55-1168

TEST ITEM SELECTION BY WHERRY-DOOLITTLE ANALYSIS

(Publication No. 11,644)

Joseph Matthew Mason, Ph.D.
Purdue University, 1955

Major Professors: Joseph Tiffin & N. C. Kephart

If item intercorrelations are available as well as item validities, it is theoretically possible to apply to items the technique of multiple correlation and regression weights, and by these analyses to select the best combination of items and their optimum weights for combining in a test. This study was designed to empirically evaluate this procedure.

A 48-item mental alertness test, developed from a preliminary form comprised of 152 items which had been administered to 300 industrial job applicants was used. This test had been developed with consideration given to the individual item validities and item difficulties, but with no consideration of item intercorrelations. The 1,128 item intercorrelations were then determined, and the items subjected to Wherry-Doolittle analysis.

Two analyses were made, the first resulting in a seven-item test form, and the second providing a six-item form; in both these analyses, the shrunken multiple was roughly 1.00 when the selection of items was stopped. The test was then administered to another group of 200 industrial job applicants and employees and scored with respect to the different item groupings. The Wonderlic Personnel Test was also administered to this group and used as the criterion for validating the different forms. The regression weights for each of the items selected by the Wherry-Doolittle were determined, and the short forms were scored using these weights, after having first been scored with the items weighted either "zero" or "one." The two selected groups of items were also combined and treated as a thirteen-item test. Correlations with the Personnel Test, coefficients of internal consistency, and coefficients of equivalence were determined for the several test forms.

Results of the investigation indicate: (1) that if a test of this type is carefully constructed by usual item selection procedures, no improvement in validity is likely to result from more refined analysis which includes consideration of item intercorrelations; (2) that a considerably shorter form of the test

may result that can be essentially as valid as the longer form; (3) that the longer tests will be somewhat more reliable; and (4) that, no increase in validity or reliability results from refined weighting of the items. 88 pages. $1.10. MicA 55-1169

AN INVESTIGATION OF THE RELATIONSHIP OF FRUSTRATION TOLERANCE TO THE PERCEPTION OF EMOTIONALLY-TONED WORDS

(Publication No. 11,655)

Homer B. C. Reed, Jr., Ph.D.
Purdue University, 1955

Major Professor: L. M. Baker

The study was designed to test the hypothesis that groups composed of individuals with low frustration tolerance would show greater variability than groups composed of individuals with high frustration tolerance with respect to recognition thresholds for emotionally-toned words. A second purpose of the study was to answer related questions concerning the effects of stress on the variability in performance of the individual.

Measures of frustration tolerance were (1) the subject's performance on a task involving the estimation of linear distance and (2) a questionnaire designed to measure the adequacy of an individual's characteristic ways of responding to frustration. Two methods were used in selecting subjects. One method employed both criteria and the other method consisted of using the questionnaire alone. Data gathered by each method were treated separately in the statistical analysis.

The results of the research supported the hypothesis that groups of low frustration tolerance individuals show greater variability than groups of high frustration tolerance individuals in their recognition thresholds for emotionally-toned words. It was also found that low frustration tolerance individuals tended to be less variable than high frustration tolerance individuals in their perceptual behavior under stress. The mean individual variance for all groups was significantly greater on the emotionally-toned words than on the neutral words. All groups of individuals showed higher recognition thresholds for unpleasant words than for pleasant or neutral words.

54 pages. $1.00. MicA 55-1170

THE RELATIONSHIP BETWEEN THE CONCEPT OF CHANGE AND CERTAIN PSYCHOTHERAPEUTIC VARIABLES

(Publication No. 11,656)

Malcolm Higgins Robertson, Ph.D.
Purdue University, 1955

Major Professor: Alvin W. Landfield

The purpose of the present research was to gain a better understanding of psychotherapy. The problem was to determine how one's concept of change is related to receptiveness to therapy as well as to actual specific behavioral changes and feeling about these changes which are facilitated both in and outside of therapy.

The theoretical background for the study was George Kelley's Psychology of Personal Constructs. The general methodology was the comparison of five different groups on responses to two questionnaires. Assumptions were discussed and a review of the literature on change and psychotherapy was presented.

The first two groups consisted of fifty-eight undergraduate students in a beginning Psychology course. The first group was comprised of those students who stated they would not accept therapy if offered to them. The second group was comprised of those students who stated they would accept therapy if offered to them. A third group was made up of nine college students who had requested therapy but who had not yet started therapy. A fourth group consisted of twenty-four college students who were receiving therapy. The fifth group was comprised of seventeen therapists. The first four groups were relatively similar in age, sex, education, and socio-economic background. All were volunteers.

Three questionnaires were used. One questionnaire dealt with acceptance or non-acceptance of therapy; a second questionnaire pertained to a stated global concept of change; and a third questionnaire pertained to specific changes in feelings and interpersonal behavior during a previous four month period, and the feeling about these specific changes.

The first two groups received all three questionnaires in a group administration. The third, fourth, and fifth groups received their questionnaires by mail. The third and fourth groups received only the second and third questionnaire while the fifth group received only the third questionnaire (which concerned the specific changes they had seen in their clients). Responses to the questionnaire were anonymous.

The primary hypothesis was that the college class subjects who verbalized non-acceptance of therapy would not have as strong a stated global concept of change as the college class subjects who verbalized acceptance of therapy, the group who were about to begin therapy, and the group who were having therapy. Furthermore, the latter three groups would not differ significantly from one another in their stated global concept of change.

The secondary hypothesis was that the college class subjects who verbalized non-acceptance of therapy would have made fewer specific changes in

feelings and interpersonal behavior during a previous four month period than the college class subjects who verbalized acceptance of therapy, the group who were about to begin therapy, and the group who were having therapy. Again, the latter three would not differ significantly from one another. In addition, the college class subjects who verbalized non-acceptance of therapy would indicate satisfaction more times concerning the occurrence or absence of these specific changes than the college class subjects who verbalized acceptance of therapy, the group who were about to begin therapy, but not in the case of the group who were having therapy. This therapy group, on the other hand, would indicate satisfaction more times concerning the occurrence or absence of these specific changes than the college class subjects who verbalized acceptance of therapy and the group who were about to begin therapy.

One supplementary hypothesis was comprised of two parts. The first part concerned predictions from this variable of specific change to the variable of the feeling about specific change for the therapy group and for the college class subjects. In the second part, the author made certain predictions about the agreement and lack of agreement between the subjects in the therapy group and their therapists in regard to specific changes made in therapy and the feeling about these specific changes.

A rationale for each hypothesis was given. Chi Squares and contingency coefficients were computed from the data.

The results on the primary hypothesis were significant for differences between the college class subjects who verbalized acceptance of therapy and the subjects who verbalized non-acceptance of therapy. However, there was no significant difference between this non-acceptance group and the beginning therapy group or the therapy group. On the other hand, the acceptance group differed significantly from this therapy group and the beginning therapy group which was not in accord with the prediction.

The results on the secondary hypothesis were generally not significant.

The results on the supplementary hypothesis were either significant or very close to significance.

The results were discussed in terms of the theory. Methodological limitations were pointed out and certain assumptions were challenged. Suggestions for further research were made.

137 pages. $1.71. MicA 55-1171

A STUDY OF THE RELATIONSHIPS AMONG EMPATHY MEASURES, RATINGS, AND PERSONAL DATA IN THE TRAINING SITUATION

(Publication No. 11,666)

Martin D. Steinberg, Ph.D.
Purdue University, 1955

Major Professor: H. H. Remmers

The Trainer Performance Indicator, a forced-choice rating device, was administered to 32 trainers and their trainees in 12 industrial and military organizations. These same trainers and their training directors filled out a graphic rating scale. The trainers, trainees, and training directors all made direct ratings and also predicted other ratings. Empathy scores and ratings were extracted from the data collected, and an intercorrelation matrix was computed which included personal data in addition to the above mentioned variables.

Ten hypotheses were tested, with the following conclusions being drawn.

1. The empathic ability of trainers is not related to the favorability of the ratings of the trainers by their trainees.
2. There is a significant positive relationship between the trainer's empathic ability and the rating of the trainer by the training director. The presence of empathy in the predictions of the trainers is demonstrated.
3. The empathy scores of trainers are significantly related to the empathy scores of their trainees.
4. The ability of a trainer to empathize with his training director is not related significantly to the amount of empathic ability demonstrated by the training director toward the trainer.
5. The ability of a trainer to empathize with his trainees is not related to his ability to empathize with his training director.
6. The ability of trainees to empathize with their trainer is not related to their rating of that trainer.
7. There may be a positive relationship between the training director's ability to empathize with a trainer and his rating of that trainer. The results are suggestive, but not statistically significant.
8. The ratings of trainers by trainees and training directors are correlated +.33, which is not significant, but which might hold up in a larger sample.
9. The relationships which hold for the total group may be quite different from those of a selected group within the total sample. Even reversals of sign occur in some correlation coefficients. General results should not be

applied to a specific group without preliminary investigative work.

10. Predictions of the future competence (as measured by ratings) of proposed trainers can be made from personnel data with considerable success.

67 pages. $1.00. MicA 55-1172

AN EXPERIMENTAL STUDY OF THE PSYCHODYNAMICS OF HUMOR

(Publication No. 11,371)

Justin Leon Weiss, Ph.D.
University of Michigan, 1955

The role of personality in humor has been the subject of considerable attention in psychoanalytic literature ever since Freud's monumental Wit and its relation to the unconscious was published in 1916. Recently a number of promising attempts, spurred on by the development of new research techniques, have been made to test these clinical observations. In the present investigation, the relationships between two major personality variables and three aspects of humor behavior have been explored.

Forty-five members of a social fraternity served as experimental subjects. The Blacky Pictures and a new auxiliary measure (Picture Problem Ranks) were used to evaluate the intensity of conflict related to five dimensions of early psychosexual development: Oral Eroticism, Oral Sadism, Anal Expulsiveness, Oedipal Intensity and Castration Anxiety. The Defense Preference Inquiry and several supplementary indices were utilized for the assessment of preferences among the following five defenses: avoidance (including repression and denial), reaction formation, projection, regression and intellectualization.

The aspects of humor behavior studied were: (1) enjoyment, (2) recall or repression, and (3) the use of humor in daily interpersonal relationships. Humor enjoyment was measured by two newly constructed tests, consisting of 40 written jokes and 30 cartoons respectively. The five psychosexual dimensions were represented equally in the themes of the jokes and cartoons. The recall or repression of humor was measured by a questionnaire which included all 70 joke and cartoon items. The interpersonal use of humor was studied by means of four items on a sociometric questionnaire. Subjects were asked to name three fraternity brothers who were outstanding in: (1) joke telling, (2) punning, (3) creating humor on the spot, and (4) lack of sense of humor.

Individuals with strong conflict in a given psychosexual dimension were found to repress, within 30 minutes, cartoons relevant to that dimension. The recall of jokes was measured after an interval which varied from one to 59 days, and the effect of conflict was less clear. Subjects who preferred the defense of avoidance repressed particularly the cartoons in dimensions where this defense was primary. This is considered to be a demonstration of experimental repression as well as a validation of the techniques used to measure avoidance.

The effect of psychosexual conflict upon humor enjoyment was such that disturbance in Oral Sadism was associated with a dislike of humor relevant to that dimension, while conflict concerning Anal Expulsiveness was related to enjoyment of anal humor. This aspect of the study provided only partial replication of an investigation by Frankel. Enjoyment of cartoons and jokes was also related to a preference for the defense of regression. Other hypotheses concerning a relationship between enjoyment and the defenses of projection and intellectualization were not confirmed. A hypothesized dislike for humor in dimensions where avoidance or reaction formation were preferred was confirmed only with respect to avoidance of Castration Anxiety. The defense hypotheses could not be tested fully in all conflict dimensions due to an insufficient number of cases.

The study of sociometric attributions of interpersonal humor behavior indicated an association between the use of punning and strong conflict.

The following conclusions can be drawn concerning the role of personality in the response to psychosexually meaningful humor: (1) the repression of humor is related to (a) preference for the defense of avoidance and (b) the presence of strong conflict; (2) the enjoyment of humor is related to (a) preference for the defense of regression, (b) the absence of conflict in the dimension of Oral Sadism, and (c) the presence of conflict in the dimension of Anal Expulsiveness. 177 pages. $2.21. MicA 55-1173

A STUDY OF SOME FACTORS RELATED TO THE PERCEPTION OF VISUALLY PRESENTED STIMULI

(Publication No. 11,670)

James Edward Wiechers, Ph.D.
Purdue University, 1955

Major Professor: John M. Hadley

Distance recognition thresholds for four neutral and four taboo words were obtained from sixty married, male, college students and sixty single, male, college students. A male and female experimenter were employed, each testing half of the married and half of the single subjects. The words used were matched for frequency in print, general familiarity and structure.

Statistical comparisons were made to determine the effect of the following on threshold difference scores: (1) sex of experimenter; (2) marital status of subjects; (3) age; (4) educational level; (5) religious preference; (6) major study; (7) fraternity membership; and (8) words, word positions, and lists used. A statistical test was made to determine whether taboo thresholds were different from neutral thresholds.

Results indicated that taboo thresholds were higher than neutral. The following were considered to be significantly related to threshold scores: (1) sex of experimenter; (2) marital status of subject; (3) educational level; and (4) word position within lists. 92 pages. $1.15. MicA 55-1174

PSYCHOLOGY, CLINICAL

AN INVESTIGATION OF RIGIDITY IN PROBLEM SOLVING

(Publication No. 11,224)

Lester Cohen, Ph.D.
The University of Nebraska, 1955

Adviser: Don W. Dysinger

A review of the literature on problem solving rigidity revealed inconsistencies in the results obtained, and suggested that rigidity as defined was not adequately measured by the tasks employed. It appeared that both the degree to which the successful solution of a task required a modification of a person's behavior, and strength of tendencies towards conformity, could be important variables in determining relationships between performance on experimental tasks and personality characteristics such as authoritarianism. The purpose of this study was to evaluate the significance of these factors, as well as the effects of stress and the role of intelligence in influencing the relationships between these other variables.

The subjects were 66 volunteer undergraduate students at the University of Nebraska, each of whom was seen on two different occasions. During the first session, each subject was administered several scales measuring authoritarian and conformity tendencies, and other personality variables. An additional measure of tendencies towards conformity was obtained at the beginning of the second session. Then, half of the subjects were given stress-inducing instructions, and the other half relatively neutral instructions. Four experimental tasks were administered, two of which measured conformity in problem solving and the other two rigidity in problem solving. Scores on an entrance examination were used as indices of intelligence level.

The relationships among the different personality and task measures were determined primarily by correlations, and by Mann-Whitney U tests where indicated. The significance of differences between the stress and non-stress conditions was evaluated by t-tests or by Mann-Whitney U tests. Partial correlations were computed to assess the role of intelligence, and other variables, in mediating several relationships between various measures.

The results suggested the following conclusions: Generally, the measures of authoritarianism and tendencies towards conformity were not consistently related to performance on the experimental tasks. Stress did not produce the hypothesized enhancement of these personality characteristics which would result in stronger relationships between these characteristics and performance on the tasks. Stress did not significantly increase either rigidity or conformity in problem solving. Intelligence level played an important role in mediating some of the relationships obtained between the tasks and several personality measures. Stress disrupts the customary problem solving behavior of an individual on a complex, unfamiliar task. A certain amount of orderliness may be useful during the solution of specific types of tasks, although this characteristic is not inherently either an aid or a hindrance in problem solving. Stress may initially intensify certain reaction tendencies of an individual such that the more methodical he is, the less readily will he adapt under stress in the solution of simpler, more familiar tasks which involve some modification of the customary problem solving procedures.

The results suggested that the possibility of curvilinear relationships between variables such as authoritarianism and tendencies towards conformity, and performance on the types of tasks used in this study, should be explored. In addition, the relevant personality variables which influence a person's reactions under stress in more complex as contrasted with more simple situations may constitute an important area for further research. Finally, it would appear that the more precise prediction of significant relationships between personality variables and experimental tasks will depend upon the exact specification of the demands a task makes upon the problem solving behavior of an individual as well as the reaction tendencies associated with particular personality characteristics. 145 pages. $1.81. MicA 55-1175

AN INVESTIGATION OF THE VALUE OF THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY AS A PROGNOSTIC INSTRUMENT

(Publication No. 11,561)

Edwin Moore Glasscock, Ph.D.
Washington University, 1954

Chairman: Assistant Professor Abel G. Ossorio

The purpose of this study was to investigate the efficacy of the Minnesota Multiphasic Personality Inventory (MMPI) as a prognostic instrument when used with institutionalized, psychotic patients. Because of the large number of patients in mental hospitals today, there is a great need for better techniques for differentiating patients with a poor prognosis from those with a good one, in order to utilize the therapeutic resources in the most effective manner.

An analysis of the MMPI's of eighty patients of the St. Louis State Hospital was made in order to

determine whether or not this test could be used to differentiate between groups of patients showing different degrees of improvement. The criterion of improvement in this study was the status of the patient, i.e., whether the patient was paroled, had been paroled and readmitted, or if he had not been well enough to be paroled at all. Some of the patients in each group were tested before and some after treatment, and both pre- and post-treatment tests were studied.

Scores were obtained on the standard MMPI scales and on the Schizophrenia, Paranoia, Hypomania, and Psychopathic Deviate sub-scales developed by Harris. Scores were also obtained on three special scales: the Anxiety, Ego Strength, and Prognosis for Shock scales. An analysis of variance was made to test hypotheses about the differences between groups with respect to the mean score on certain scales. Also, hypotheses were made about specific prognostic signs in terms of the proportion of individuals within a designated criterion group having a high score on a scale or a combination of scales. These hypotheses were tested by using chi square.

An analysis of the post-treatment tests revealed little differences between groups, but more success was achieved in analyzing the pre-treatment tests. Patients with a good prognosis tended to have a lower score on the Anxiety and Schizophrenia scales prior to treatment. The difference between the means of the groups was significant at the .05 level of confidence.

By selecting those scales which tended to show differences in the direction hypothesized, nine prognostic signs were assembled. A patient whose MMPI showed three or more of these signs was judged to have a poor prognosis. Using these signs, it was possible to identify correctly 77% of the pre-test cases ($x^2 = 10.46$, significant at the .01 level of confidence). These signs are:

1. F of 65 or more and K above 50.
2. Sum of the Psychotic scales greater than Sum of the Neurotic scales.
3. Pa and Sc both 65 or more.
4. Ma 65 or more.
5. Amorality score of 4 or more.
6. Ego Inflation score of 7 or more.
7. Presecutory Ideas score 8 or more.
8. Defective Control and Inhibition score 5 or more.
9. Sensory-Motor Dissociation score 8 or more.

In summary, the results of this study suggest that the MMPI may be used to advantage as a prognostic instrument with institutionalized psychotic patients. The large percentage of patients accurately identified by means of a series of prognostic signs indicates that this approach may be one of the most fruitful ones in improving the use of the MMPI. However, more comprehensive studies are needed to develop better techniques for evaluating the prognosis of psychotic patients. Perhaps the best results will be achieved with a combination of prognostic signs from different tests and from case history material.

112 pages. $1.40. MicA 55-1176

SOME BEHAVIORAL CORRELATES OF EMPATHY

(Publication No. 11,455)

Stanley Hayden, Ph.D.
Columbia University, 1955

This study was concerned with relationships among accuracy of prediction, empathic behavior, and other kinds of interactions in a group situation.

The subjects were 48 graduate students at Teachers College, Columbia University, who participated in group psychotherapy over a period of five weeks. The subjects were divided into seven subgroups: one group of eight members, two groups of six, and four groups of seven members. The main criterion for predictive ability (i.e., accuracy of prediction of perceived social choices) was the score each subject obtained when predicting the social choices that the other group members had made on a 16 item social choice questionnaire. Empathic behavior and other kinds of group interactions were scored by two judges independently. These judges ranked the members of each subgroup on eight interaction categories. These rankings were then converted into standard scores.

The hypotheses dealt with relationships between accuracy of prediction and the other variables. The data were treated by correlational techniques. The hypotheses relating social prediction score positively to the following variables were accepted: (1) empathic behavior in the group, (2) giving interpretation and opinion, (3) giving advice and suggestions, and (4) acting similarly to the group leader. All other hypotheses were rejected.

The results were taken to mean that predictive ability is closely associated with empathic behavior. This conclusion seemed justified, not only because these two independent measures were shown to have a low but significant relationship to each other, but also because the other interaction patterns (i.e., giving interpretation, giving advice, and assuming leadership) that were shown to be positively related to predictive score are closely associated with empathic behavior.

At the same time, while it could not be definitely established, considerable evidence emerged that accuracy of prediction may not be the best operational measure of empathy. For example, while there were no significant relationships between social prediction score and realistic appraisals of self and others, significant positive relationships were found between empathic behavior and these measures. Furthermore, it was demonstrated that empathic behavior was related to the extent to which an individual was accepted by the group. Again in this case, no relationship had been found with social prediction score. Thus, this study raises the question that perhaps empathic

behavior is not the only determinant of achieving high prediction scores, or the converse, that other variables may be more directly associated with empathic behavior than is accuracy of prediction.

The results were interpreted within the context of other empirical studies dealing with empathy. Thus, it would seem that, in accordance with Dymond's findings,[1] high-scorers on prediction tests are healthier, more mature people since they tended to interact with their peers in positive, constructive, outgoing fashions. The high-scorers also are people for whom more accurate predictions are made, hence it could be assumed that they are people who are more expressive and more consistent in their behavior. This finding also could be taken as indicative of a more constructive attitude towards others.

78 pages. $1.00. MicA 55-1177

Rosalind F. Dymond. Personality and empathy. J. Consult. Psychol., 1950, 14, 343-350.

A PSYCHOLOGICAL STUDY OF MENSTRUATION

(Publication No. 11,298)

Harold Stephen Housman, Ph.D.
University of Michigan, 1955

The purpose of the present research was to study by controlled, systematic, experimental procedures the psychological concomitants of menstruation.

The selection of subjects was governed by the following prerequisites: (a) the availability for study of an adequate number of women of child-bearing age, free from organic gynecological involvement, whose menstrual data could be accurately but unobtrusively observed and reported; (b) the need to keep the subjects from perceiving a connection between the gathering of menstrual data and the psychological work-up; and (c) the definite desirability of keeping from the examining psychologist knowledge of the menstrual phase and functioning of the women being tested.

The final sample consisted of 39 women, with the following identifying characteristics: white; institutionalized; non-defective schizophrenics with no organic brain disease; free of gynecological involvement; currently menstruating but not older than 45; not being treated with electro-shock or sedation; and with no recent psychological testing experience. These women were divided, before psychological testing, into groups of 19 regular and 20 irregular menstruators on the basis of daily plottings of menstrual data over a period of four months.

The sources of data were: (a) a Menstrual Questionnaire administered by ward doctors sufficiently prior to the psychological testing to forestall the subjects' connecting the two; (b) a Rorschach and Blacky test administered to each subject during and between menstruation. Controls were employed for test-retest and examiner influence.

The major results can be summarized as follows:

1. Common to all the schizophrenic women studied was a marked decrease in sexual confusion during menstruation. Concurrently, they seemed to have an increasing need for affection and approval, and so were more sensitive to interpersonal slights. Reflective of this, their anxiety level was indicated to be higher during the menses. Also during this time there was an increased defensiveness in the more direct expression of sibling rivalry.

2. The general personality characteristics distinguishing the groups of women with physically different menstrual patterns were reflected in their non-menstrual test findings. The irregular, in contrast to the regular menstruators, were characteristically anal explusive. They professed more unconcerned acceptance of their sexual role but gave less evidence of a genuine feminine identification than did the regulars. The irregulars showed less concern with conformity. Lastly, they appeared less involved with sibling rivalry and instead gave more direct expression to feelings of frustration and rejection by their parents.

3. During the menstrual flow, the psychological changes of the two groups can be conceived as basically divergent modifications in ego effectiveness. The regular menstruators exerted much more effective control in coping with their impulses and external reality. The irregulars, in sharp contrast, showed a marked abandonment of ego constraints. The mobilization of compulsive defenses by the regulars and the expulsive behavior of the irregulars during their flux seemed to reflect each group's characteristic mode of coping with anal eroticism. Further, menstruation was accompanied by an exacerbation of the masturbatory conflict among the irregulars and a contrasting alleviation of the same conflict for the regulars.

Finally, the implications of the reported findings for theory, research, and practice were noted.

121 pages. $1.51. MicA 55-1178

LEARNING AND LANGUAGE IN APHASIC PATIENTS

(Publication No. 11,459)

Leo Katz, Ph.D.
Columbia University, 1955

The study investigated the relative effectiveness of directed and undirected learning in aphasic patients. Observations about the performance of aphasics made by different workers and by the experimenter were the source of the major hypothesis which stated that in aphasic patients, the normally more effective directed learning situation is not significantly more effective than the undirected learning situation.

In order to test this hypothesis, two equivalent series of postage stamps were exposed to 25 predominantly expressive male aphasic patients between the ages of 19 and 51, once with instructions to remember them (directed set) and once with instructions to evaluate the stamps aesthetically (undirected set). Retention of the material was tested and the scores

obtained by the aphasics compared with those obtained by a control group of 25 male non-aphasics. Results indicated that directed learning is not significantly more effective than undirected in aphasics, whereas in non-aphasics it is.

Fear of failure was considered a possible obstacle which, in the aphasics, might have interfered with the gains normally derived from motivation to learn. In order to expose the subjects to material dealing with success and failure, they were shown a series of photographs depicting successful mastery of physical handicap (achievement-related material) and they were asked to describe the situations represented in the photographs. The hypothesis stated that the speech of the aphasics would show significantly more disturbance in response to these achievement-related photographs than in response to an equivalent series of "neutral" photographs. Four criteria were employed to measure speech disturbance. Results indicate significantly more speech disturbance of the aphasics in only two of these four criteria. Despite the ambiguous nature of these results, it was possible to conclude from additional sources of information (post-experimental inquiry) that feelings of anxiety and discomfort were present in the aphasics when they were dealing with achievement-related material.

Limitations of the study are due to the dearth of the learning tasks employed, the limited number and the highly selected nature of the aphasics, and the uncertainty about the nature of the process which prevented increase of learning efficiency of the aphasics in the directed learning situation.

The results of the study, if verified upon replication and elaboration, call for a re-examination of the principle that set and instruction to learn are universally more efficient in promoting learning than the absence of set and instruction to learn.

Suggestions were made for approaches to the retraining of aphasics designed to reduce fear of failure and to reinforce effort-making on the part of the aphasics. 96 pages. $1.20. Mic 55-116

THE EFFECT OF ANXIETY LEVEL UPON MOTOR LEARNING, LEVEL OF ASPIRATION, AND WECHSLER-BELLEVUE SUBTEST PERFORMANCE

(Publication No. 11,565)

Ruth Gadbois Matarazzo, Ph.D.
Washington University, 1955

Chairman: Carl E. Sherrick, Jr.

According to Hullian theory, learning is a multiplicative function of habit strength and drive, among other variables. Mowrer has postulated that anxiety is an acquired drive, and Miller has shown that rats can learn to perform new responses under the motivation of anxiety. Taylor studied the effect of low and high anxiety states upon defense conditioning in human subjects. She found that her most anxious subjects developed a conditioned eyelid response more rapidly than did her non-anxious subjects. Subsequent investigators have discovered that the relationship is a complex one, depending upon the difficulty of the task, the number of available competing response tendencies, etc. When the whole range of anxiety was used, a curvilinear relationship was found.

The present study was designed 1) to extend to the area of motor learning the studies relating anxiety to learning efficiency; 2) to test the common clinical assumptions regarding the effect of anxiety upon Wechsler-Bellevue scatter; and 3) to study the effect of anxiety upon level of aspiration. Eighty medical and psychiatric Veterans Administration patients were divided into five groups which were equated for age, I. Q., and education, group one having the lowest Taylor anxiety scores, and group 5 the highest. As would be predicted, the mean anxiety score for the medical patients was significantly lower than that of the psychiatric patients.

It had been hypothesized that a curvilinear relationship would be found between anxiety level and performance on the motor task, the moderately anxious groups giving the best performance. An F-test indicated that there was no relationship, for this population, between anxiety as measured by the Taylor Scale, and performance on the pursuit meter. Each of the Wechsler-Bellevue subtests was analyzed with respect to its relationship to anxiety level. It was hypothesized that digit span and, to a less extent certain other subtests, would be vulnerable to anxiety, as stated by Wechsler, and Rapaport, Gill, and Schafer. Further, it was predicted that these, and perhaps all subtests in which time was an important factor, would be curvilinearly related to anxiety level, the moderately anxious subjects again having the best performance. There was found to be no relationship between anxiety level and any of the subtests.

No relationship was found, also, between anxiety level and level of aspiration or goal discrepancy. It was noted, however, that the low anxious group tended to have a lower level of aspiration than the other groups, and that none of the subjects in that group predicted a goal above what he was able to attain. This could be a function of low drive level or of a defensive attitude, designed to protect the subject from failure. Using only the extreme anxiety groups (upper and lower 20%) as Taylor had done, there was still no relationship between anxiety level and any of the measures mentioned above. Analyzing the validity scales from the MMPI (included in the Taylor Anxiety Scale), it was found that the L, F, and K scales were related to the anxiety scores. These indicated that the low anxiety groups were less candid or tended to put on a defensively "normal" appearance, and that the high anxiety groups were apparently more disorganized. However, the subjects in the present experiment do not appear to differ from those of other related experiments in this regard. It was concluded that the negative results reported here are probably valid, but that there may be variables other than "anxiety" reflected in Taylor scores, and it is hoped that future research can help to identify some of the other factors causing the large

variance which is apparent in all the studies reported in the literature.

82 pages. $1.03. MicA 55-1179

PERSONALITY RIGIDITY AS A DISTINGUISHING FACTOR BETWEEN NORMAL AND NEUROTIC BEHAVIOR

(Publication No. 11,653)

Leonard K. Phillipson, Ph.D.
Purdue University, 1955

Major Professor: John M. Hadley

A multiple choice sentence completion test of rigidity consisting of 90 items was constructed and administered to groups of normals and neurotics together with another test of rigidity, the Triangle to Circle transition series. An attempt was made to differentiate the two groups on the variable studied with sex, age, education and occupation levels being controlled. For each of the two measures of rigidity, the tested hypothesis was that neurotics would manifest rigidity to a greater degree than would normals.

In analyzing the results it was discovered that the normals were significantly more rigid on both measures, although better educated, than the neurotics. When education was controlled through the use of matched groups, reducing the total N from 187 to 122, normals were found to be more rigid on the multiple choice sentence completion test (non-significant) and significantly more rigid than the neurotics on the transition series. The two tests were found to be only slightly correlated, r = +.17, and the item analysis of the multiple choice sentence completion test revealed no significant differences between groups in the use of any of the four modes of adjustment which were offered in the test. The results were not supportive of the hypothesis and were interpreted as questioning the general conception of rigidity as being more characteristic of neurotic than of normal behavior.

In view of the obtained reliability coefficients for three of the four modes of adjustment incorporated into the multiple choice sentence completion test and its advantage of yielding completely objective indices of rigidity, it was felt that further work in refining and standardizing this test could eventually result in a useful clinical device. Although the test could not discriminate between groups as well as the transition series, suggestions have been made to improve it, through future research, in this and other respects.

65 pages. $1.00. MicA 55-1180

SOME PERSONALITY CORRELATES OF RELIGIOUS ATTITUDE AND BELIEF

(Publication No. 11,466)

James Gilmour Ranck, Ph.D.
Columbia University, 1955

Problem

In previous studies of relationships between religious ideology and personality differences, theory and research have suggested substantial associations of dependency, suggestibility and authoritarian ideology with religious conservatism. Conversely, data relating submissiveness and psychopathology to particular religious ideology have been equivocal. This study empirically reexamined these relationships, assuming experimentally that religious ideology is primarily a cultural phenomenon. It was hypothesized that authoritarianism and submissiveness are significantly related to specific religious ideology, and that psychopathology is not.

Procedure

It was believed that utility of the data would be increased by more accurate definition of differences in religious ideology along a conservative-liberal continuum, and use of a larger and more homogeneous sample, known to be particularly familiar, and actively concerned, with religious ideology. Consequently, the sample was composed of 800 Protestant, male, theological students, representing the entire theological continuum from extreme conservatism to extreme liberalism. Drawn selectively from 28 schools, the subjects' place of residence included every major geographical area of the United States. The measurement inventory, completed anonymously, consisted of a 50-item questionnaire dealing with biographical background factors, and 12 scales for testing the specific hypotheses. The latter included the Levinson-Lichtenberg and McLean scales of religious attitude and belief; authoritarianism scales adapted or developed from the "California study"; a revision of the Bernreuter dominance-submission subscale; several MMPI subscales; and the Wallen Food Aversion test of neurotic tendency. Pearsonian correlations were obtained between independent and dependent variables. Multiple and partial correlation techniques were used to test comparative predictive power of dependent variables, and chi square to study conservative-liberal difference-similarity with parents in religious and family ideology. The .01 level of significance was adopted throughout.

Results

In the main, the obtained data supported the experimental hypotheses. Authoritarianism was found to have statistically significant and substantial relationships with religious conservatism. Submissiveness born a significant but low relationship to religious conservatism. Neurotic, paranoid and psychasthenic syndromes were insignificantly related to specific religious ideology. Significant but low correlations

were found between (a) impulsivity, and (b) feminine interests, and religious liberalism, while a second measure of neuroticism was qualifiedly related to religious conservatism. Of all dependent variables involved in testing the experimental hypotheses, traditional family ideology had substantially the highest correlation with religious conservatism, and the greatest predictive power for religious attitude and belief. Sociological background variables were insignificantly related to religious ideology, except for (a) a low relationship between religious conservatism and rural residence, (b) a significant correlation between religious liberalism and higher level of education, and (c) for religious liberals, as contrasted with conservatives, markedly greater differences with parents in religious and familial attitudes.

Conclusions

It was concluded that differences in adult religious attitudes and beliefs, as revealed by position on a conservative-liberal continuum, are not generally or substantially associated with pathological symptoms. Rather, they appeared to be primarily a cultural phenomenon, related, either as products of conformity, permissiveness or reaction, to the early environment, and specifically to family influences. While the obtained correlations were of such magnitude as to support the hypotheses, even the highest of them – authoritarian family ideology and religious conservatism, .53 – had only tenuous diagnostic and predictive utility. This finding suggested that a major goal of further study should be the discovery of those attributes of personality which maximally determine or covary with position on a continuum of religious ideology. Studies of the present or similar data by factorial techniques and analysis of covariance, and intensive case studies of religious extremists – conservative and liberal – might be particularly useful in the development of additional experimental hypotheses. 172 pages. $2.15. Mic 55-117

A STUDY OF INTELLECTUAL FUNCTIONING IN TERMS OF RORSCHACH LOCATION SCORES AND FREE VERBAL EXPRESSION

(Publication No. 11,468)

Margaret Beron Scales, Ph.D.
Columbia University, 1955

The present study was concerned with the relationships between two sets of operations defining five traits of intellectual functioning. One set of defining measures involved the traditional Rorschach manner of approach scores, the other a series of ratings made of verbalizations during group therapy sessions. The traits were verbal productivity, abstract-general thinking, concrete-specific thinking, critical attitude, and oppositional tendency. The general hypothesis held that these two groups of scores were interrelated in such a way as to form a coherent system.

The Rorschach protocols were scored for R, W%, W+%, D%, d%, S, A%, Z, Hd+Ad:H+A, and M:Sum C.

The verbalizations during group therapy were defined for three judges in terms associated with typical interpretations made of Rorschach location scores. Interjudge reliabilities on samples of both the Rorschach material and the group therapy material were sufficiently high to suggest that the scoring methods are readily communicable and reliable from one scorer to another.

The hypothesized relationships were tested by calculating Pearson product-moment correlations among the relevant variables, or chi-square where appropriate, adopting the .05 level of significance.

Split-half (odd-even) reliabilities obtained for both sets of measures were sufficiently high to warrant further investigation of substantive hypotheses.

Of the eleven hypotheses dealing with asserted relationships among certain Rorschach scores, eight were confirmed. The remaining three which were not substantiated were all based on asserted relationships between M:Sum C and other aspects of Rorschach performance. It is suggested that the claims commonly made in Rorschach literature are valid concerning the relationships among the location categories and between the location categories and certain other Rorschach indices, with the exception of the Experience Balance.

Of the ten Rorschach categories under consideration, six show some relationship to the categories of verbal behavior supposedly defining the same intellectual traits. In five cases this appears to be a genuine relationship which is independent of variability in R. With respect to the white space response, the relationship seems more apparent than real and does not withstand the effect of partialling out and the influence of R. Although the magnitude of the relationship in no case appeared large enough to indicate diagnostic utility in individual application, with respect to these particular traits the two sets of measures form a consistent system.

Of the five Rorschach categories which show a genuine relationship to the nontest measures, four involve intellectual behavior on the abstract-concrete continuum. Although the Z score failed to yield a significant correlation with the verbally defined measure of generality, it does appear to be positively related to Rorschach measures of generality and negatively related to both Rorschach and nontest measures of specificity.

The remaining Rorschach score which demonstrates a relationship to the comparable nontest categories is R.

Neither of the Rorschach indicators of critical tendencies show any relationship to the behavioral measures of this variable.

The findings concerning the white space response and the small detail response raise some doubts regarding the general applicability of the interpretive hypotheses commonly assigned to these two Rorschach indices and suggest a need for re-evaluation and refinement of Rorschach theory in this area.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

Finally, none of the sex differences traditionally ascribed to Rorschach scores is confirmed. It is suggested that there is a need for further study of sex differences at various intellectual levels and that Rorschach theory, as it now stands with regard to expected sex differences, is in need of some modification. 117 pages. $1.46. Mic 55-118

ANXIETY: ITS RELATIONSHIP TO SELF-EVALUATION

(Publication No. 11,606)

Elizabeth Johnston Scheide, Ph.D.
University of Pittsburgh, 1955

This paper describes an investigation of the relationship between anxiety and self-evaluation; the study involved a replication of the initial design.

Subjects were women university students drawn from one of several sections of an educational psychology course.

Three definitions of anxiety were used: a subject's score on the Manifest Anxiety Scale; clinicians' ratings of each subject's relative anxiety, based on responses selected by the experimenter from that subject's Rorschach record; and each subject's self-rating of anxiety on a one-item Self-anxiety scale.

The presentation of the Rorschach cards was modified to limit the number of responses and to provide a maximum number of responses containing human content. Responses selected to be sent to the judges included only those whose content was clearly human, human detail, human-like, or human anatomy. Each judge was requested to use his own working definition of anxiety; no other definition of anxiety was provided.

Each subject was asked to perform and to rate the performance of four tasks. Of the four tasks to be performed and rated, two involved primarily verbal behavior and two required nonverbal behavior. Three of the four tasks were relatively nonstructured; three of the four tasks were rated in the absence of the performance-stimulus.

Self-evaluation was defined by self-rating scores of the subject's performance on the objective and on the subjective tasks. A task was classified as objective when self-ratings by a subject on this task were found, in both initial and replication groups, to be correlated with the rating given to that subject by others.

Two self-rating scores were used. These were (1) average self-ratings on the performance tasks and (2) average "inferred" self-ratings, that is, the average discrepancy between self-rating by a subject of task-performance and the rating given by that subject to the task performance of others.

The findings may be interpreted as follows.

In the absence of a definition, clinicians' judgments of anxiety from selected Rorschach responses were found to be reliable. A subsequent pilot study showed a significant positive correlation between clinicians' judgments of anxiety made from Rorschach responses selected according to the criteria previously described and their judgments of anxiety made from the full Rorschach protocols.

Self-ratings were found to be objective only when the performance-stimulus was present at the time of rating of the performance.

Neither of the objective self-rating scores was shown to be a function of anxiety as measured in the present study.

Both the self-rating and the "inferred" self-rating scores were shown to vary inversely with self-ratings of anxiety and with clinicians' ratings of anxiety, when these self-rating scores were obtained from the subjective tasks.

Only the first of these two subjective self-rating scores was found to be a function of Manifest Anxiety Scale scores: subjective self-rating was shown to be a nonlinear function of the MAS scores.

Although no relationship was seen to exist between the clinicians' ratings of the subjects' relative anxiety and the Manifest Anxiety Scale scores, each of these anxiety measures correlated positively with the subjects' self-ratings of anxiety.

It has been concluded from the data that clinicians, in referring to a subject as anxious, are not classifying the subject in accordance with "manifest anxiety." However, self-anxiety ratings may be said to measure, in part, both "clinical" and "manifest anxiety."

The data also suggest that on those tasks which allow for little "reality testing" a subject's self-evaluation of that task-performance tends to be lowered in the presence of high anxiety.

137 pages. $1.71. MicA 55-1181

VARIOUS EFFECTS AT MATURITY OF SHOCKING, IGNORING, OR GENTLING RATS DURING INFANCY

(Publication No. 11,535)

Jack Hugh Scott, Ph.D.
University of Illinois, 1955

This experiment was planned to test in one study the reproducibility of a number of different effects of infantile experience as reported by such previous investigators as Bernstein (1952, 1954), Weininger (1953, 1954), Greenman and Duhring (1923), Hall and Whiteman (1951), Pilgrim and Patton (1953), and others. The infantile experiences concerned are intermittant shock on the feet for 10 minutes a day while held by the experimenter, being ignored in a small cage, and being petted 10 minutes a day. The experimental groups (shocked, ignored, and gentled) were established from a population of 60 Sprague-Dawley animals; the three heaviest males and the three heaviest females being chosen from each of ten litters. The animals were assigned to the three groups by means of the split-litter technique and a procedure of systematic randomization.

The animals were weaned at 21 days and started on the experimental conditions when 23 days old. The

shocking and gentling were administered for 10 minutes a day for 21 days after which routine care was instituted. Records were kept of the food and water intake during the 21 day experimental period. Six-day weight records were kept throughout the length of the experiment. All groups received food and water ad libitum except during a period of relative food deprivation in adulthood.

Variables other than weight and food-and-water intake chosen to test the effects of these infantile experiences include: (a) nonshock activity, (b) freezing and inactivity (fearfulness) during conditioning (shock) trials, and during extinction trials; all measured in the Miller-Mowrer box. Additional variables chosen to test the differences between groups in terms of their resistance to stress were (a) unusually high temperatures, (b) relative food deprivation, and (c) injection of thiourea of a toxic quantity.

1. The finding for Bernstein (1952, 1954) and Weininger (1953, 1954), of a significant difference in weight between the gentled and the ignored groups was not substantiated. The per cent gain in weight for the shocked animals, however, was significantly less than that of either the gentled or the ignored groups at the close of the 21 days of shocking and gentling.

2. Weininger's (1954) finding that the weight differences between the gentled and ignored groups continued to increase after termination of gentling experience was not substantiated as is evident from the fact that no significant differences existed between any two groups 74 days after termination of infantile experience. The possibility is discussed that Bernstein (1952) and Weininger (1953, 1954) may have been dealing with weight differences which developed as an artifact of small, nonsignificant, initial differences in weight in favor of the gentled group.

3. Bernstein's (1954) finding that food and water intakes were not significantly different was substantiated when tested statistically. A trend was noted, however, for the gentled group to eat and drink the most, and the shocked group the least.

4. Bernstein's (1952) finding of greater activity by the gentled group was not supported. The reliability of the present activity measure was questioned.

5. Differences (nonsignificant) in activity between groups on the conditioning and extinction trials in the Miller-Mowrer box suggests that there may have been some effect of a learned order.

6. The gentled animals were not more resistant to stress situations as has been reported. A nonsignificant trend in the response of the animals to usually high temperatures, food deprivation, and a toxic injection of thiourea suggests the opposite hypothesis; that under the conditions employed the gentled animals may have shown less, not more tolerance to stress.

7. Strain differences and differences in procedure, especially with regard to the minimal handling of the ignored animals, were recognized as possible factors in explaining the present findings in the face of the previous evidence by Bernstein, Weininger, Greenman and Duhring, and others.

85 pages. $1.06. MicA 55-1182

A STUDY OF THE PERSONALITY VARIABLES RELATED TO ASSAULTIVE AND ACQUISITIVE CRIMES

(Publication No. 11,662)

Elsie Marie Sjostedt, Ph.D.
Purdue University, 1955

Major Professors: Dr. L. M. Baker
Dr. A. W. Landfield

The purpose of this study was to compare the performance of assaultive and acquisitive offenders on test factors which might be related to personality variables. It was assumed that the two groups would not exhibit the same characteristics on the basis of their different criminal behavior. The hypothesis was made that performance on the tests would differ.

Fifteen questions were posed regarding the differential importance of certain variables in the personality structure of individuals committing assault and theft. The direction of differences in the two groups on 13 test factors bearing on the following four variables was predicted: (1) rational control over expression of feelings and impulses, (2) hostility, (3) activity level, and (4) dependency needs. No predictions were made regarding the relative performance of the groups on factors measuring the following personality variables: intellectual ability, endowment and intellectual energy, fantasy activity, conventionality of thought processes, negativism, "sensitivity" to emotional stimuli, self-examining qualities, level of anxiety, erotic needs, intellectual control over behavior, interest in and understanding of people, and concern over bodily functions.

To answer these questions 30 women convicted of assaultive crimes and 30 convicted of acquisitive crimes were studied. The Wechsler-Bellevue Intelligence Scale, Rorschach test, and Tomkins-Horn Picture Arrangement Test were administered to each subject. Thirty-four variables were extracted from these tests. The influence of intelligence and productivity on the Rorschach, on other Rorschach test factors, was factored out by the analysis of covariance technique. Because the two groups differed so slightly on those two independent variables, adjustment for them did not change any conclusions. Therefore, the corrected results were not reported. With the Tomkins-Horn test factors only simple analyses of variance were carried out to determine whether the means of the two groups differed significantly.

Of the factors predicted to differentiate between the two groups the following seven did so at the five per cent level: C, FC, YF, and Hostility content on the Rorschach, and Low Work Interest, High Work Interest, and Passivity on the Tomkins-Horn test. Evidence was secured for the differential importance of these three variables: rational control over expression of feelings and impulses, hostility, and activity level. Dependency needs, as measured by Dependency content on the Rorschach, did not constitute a significantly discriminative variable. Level of anxiety, which was not predicted to vary to a significant degree between the two groups, did so.

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On the basis of these findings, assaultive individuals were characterized tentatively as active, tense, aggressive, and impulsive individuals. Acquisitive persons seemed relatively restrained in self-expression and somewhat passive. They appeared rather conforming, whereas the picture of assaultive individuals suggested considerable stress within the environment, as well as personal conflict.

This investigation represented a preliminary attempt to determine in what ways, on what personality dimensions, two different criminal groups were different. Certain discriminating personality variables were isolated and identified. Until this area has been studied further, however, conclusions must be regarded as tentative. 83 pages. $1.04. MicA 55-1183

AN INVESTIGATION OF THE RELATIONSHIP BETWEEN MANIFEST ANXIETY AND MEASURES OF PERSONALITY FLUIDITY

(Publication No. 11,876)

Colin McIntosh Slade, Ph.D.
Syracuse University, 1955

The purpose of this study was to test the general hypothesis that the concept of manifest anxiety is related to the concept of a highly fluid life-space. The theoretical basis for the study was taken from Lewin's topological and vector psychology. The specific deductions leading to the empirical hypotheses are based on the assumption of differences in personality structure which are related to the hypothetical construct fluidity. Fluidity refers to the degree of permeability of the hypothetical boundary between regions of the life-space.

From a review of clinical observations and of studies concerned with manifest anxiety, it was found that there is some basis for coordinating manifest anxiety with the highly fluid life-space. In order to test this proposition, two deductions were made concerning the structure of the highly fluid psychological field. These were: (a) the degree of differentiation of the psychological field is an inverse function of the degree of fluidity, and (b) the stability of the psychological field is an inverse function of the degree of fluidity.

The primary data were obtained by comparing the mean scores of a high-anxious group (HA) with the mean scores of a low-anxious group on measures of fluidity. These measures were derived from three tests.

The selection of forty high-anxious and forty low-anxious subjects was made from 407 undergraduates tested with the Taylor Scale of Manifest Anxiety. The following tests provided the measures of fluidity:

Test A was a test of recognition-memory. A list of twenty-four six-letter nonsense words were presented in six random orders during the learning session. The subjects then selected from a list of forty-eight nonsense words the twenty-four words recognized as being most familiar. The original words were systematically altered so that a dimension of similarity was defined in terms on the number of letters in the word which were common to both lists. Thus a curve of stimulus generalization could be plotted for both groups. The HA subjects were predicted to show a higher gradient of stimulus generalization.

Test B, a perceptual-identification test, consisted of alternate series of twelve letter patterns presented tachistoscopically for one-half second. The letters were printed equidistantly from each other inside the periphery of a circle two and one-half inches in diameter. The subject was instructed to copy the letters identified after each trial. Scores obtained were: (a) the number of substitution errors, and (b) the number of different patterns or a Variability score. The HA subjects were predicted to make more substitution errors and to be more variable.

Test C presented an ambiguous stimulus which gradually became more distinct as a series of cards was presented. From a list of possible solutions, the subject was required to "guess" the final figure as early as possible. After the first response, he made a choice on each subsequent card. A Discrepancy score, the difference between the first and correct response, was the primary measure of discrimination. The number of "guesses" prior to the correct response was the Variability measure. The HA subjects were predicted to show poorer discrimination and to be more variable.

The results did not support a theoretical statement predicting lower scores for the high-anxious subjects on Discrimination measures. On tests B and C the difference on these measures were in the predicted direction. On test A the differences were in the opposite direction (p-level, .05). These conflicting results were discussed in terms of the theory.

Measures related to the second deduction were found to differentiate the groups at a significant level. The finding of a relationship between measures of variability and manifest anxiety was interpreted as support for the theory.

194 pages. $2.43. MicA 55-1184

AGE DIFFERENCES IN RIGIDITY AS REVEALED IN ATTITUDE SCALE RESPONSES

(Publication No. 11,878)

Charles Taylor, Ph.D.
Syracuse University, 1955

A conjecture frequently advanced by professional and layman alike is that rigidity is essentially characteristic of the older adult. Although direct experimental evidence for this viewpoint is scanty, much peripheral evidence does give it support. Rigidity is closely related to stress situations which are likely to arise, in the older person, from physical, mental and status losses, from a narrowed life, and from changing interpersonal relationships.

Numerous theoretical formulations of rigidity exist. One of these is a concept called "tolerance of

ambiguity," advanced by Frenkel-Brunswik after early studies of ethnocentrism and later supported by further attitudinal and perceptual researches. The person who displays this trait may be expected to attempt to escape from ambiguous threat situations; if this is impossible, he will tend to structure unrelated elements together and to resort to crude, extreme, black-white differentiations.

The intolerance of ambiguity in the usual experiment has been measured by the point at which structure is achieved in the course of a series of pictures ranging from one realistic portrayal through changing, ambiguous pictures to an emerging, new realistic portrayal. Less artificial stimuli might be found in the items of attitude scales which have to a greater or lesser degree the ambiguity which is present in all verbal material. It was hypothesized that the rigid person could react to this sort of ambiguity in the following ways, three allied to the concept of intolerance of ambiguity and the last related to classical perseveration:

1. He would tend to endorse statements in direct conflict with one another.
2. He would tend to use the extremes of a response continuum.
3. He would tend to avoid the neutral point of a response continuum.
4. He would tend to fall into extended response sequence patterns.

These speculations, stated operationally, serve as hypotheses in the study, the assumption being that such evidences of rigidity would be more characteristic of the older than the younger adult.

Three age samples of 200 each, aged 25 to 35 years, 40 to 50 years, and 55 to 65 years, were gathered from a population of male "service" club members. The groups did not differ significantly in religion, education nor professional callings. A battery of five Thurstone scales, each with items arranged in ascending scale values, were administered to the three samples, who reacted to each item in one of five ways: strong agreement, agreement, neutrality, disagreement, or strong disagreement.

Analyses in terms of the hypotheses led to the following conclusions:

1. In all five scales and all four measures, age trends were as hypothesized. In the use of the continuum extremes, avoidance of neutrality, and length of response sequences, differences in means were significantly greater than chance. In the fourth measure, the simultaneous endorsement of conflicting items, differences were significant in three of five scales.
2. Intercorrelations in the five scales in each measure of rigidity ranged from .14 to .59, showing that the scales themselves have some influence on the amount of rigidity shown.
3. Intercorrelations among the four measures of rigidity showed a weak common factor, the coefficients being of the order of .25.
4. The measures of rigidity were correlated with attitude scale scores. These correlations, of the order of .25, show a tendency for rigidity to be related to a conservative attitude position.

Additional descriptive analyses reveal that the older adult is likely to be more conservative than the younger although not significantly so; that variability in attitudes increases with age; and the intercorrelations between attitude scale scores are higher, though not significantly so, in the older groups, giving some scant support for a more stable core of opinion.

118 pages. $1.48. MicA 55-1185

THE RELATIONSHIP BETWEEN EXPERIMENTALLY INDUCED STRESS AND THE CHARACTERISTIC MODE OF EXPRESSION AND LEVEL OF ANXIETY

(Publication No. 11,367)

Helen Mary Maertens Wadsworth, Ph.D.
University of Michigan, 1955

This research represents an attempt to study experimentally induced anxiety through the exploration of relationships among physiological, performance and clinical measures.

The physiological indices consisted of the galvanic skin response (GSR), radial pulse rate and respiration amplitude. Performance was measured by the number of errors made during the execution of a complex perceptual-motor task. The physiological and performance measures were recorded simultaneously during the stressful and relatively non-stressful situations, namely, the shock session and the null session. Two clinical measures from the Minnesota Multiphasic Personality Inventory (MMPI) were used. One of these was the expressor-repressor ratio developed by Janda as a measure of mode of handling anxiety. The ratio is designed to distinguish between subjects who tend to express anxiety directly (expressors) and those who, by various defensive measures, inhibit the direct discharge of manifest anxiety (repressors). The second measure was of total anxiety, which was operationally defined as the sum of the expressor and repressor scores (depression, psychasthenia, hysteria and hypochondriasis).

The MMPI was administered to 160 volunteer female graduate and undergraduate students attending the University of Michigan. From this original group 20 repressors and 19 expressors were chosen on the basis of extreme scores. These groups were equivalent in terms of mean total (MMPI) anxiety scores.

The following are our most significant findings:

1. The results indicate significant differences between shock and null sessions for performance errors, GSR and pulse rate.
2. Contrary to prediction expressors did not differ from repressors in performance.
3. Repressors showed significantly higher

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respiratory volumes in both sessions while expressors showed significantly higher pulse rates during the null session. There were significant differences between these groups in the variance of several of the physiological indices.

4. The measure of total anxiety derived from the MMPI yielded no discriminations in either performance or any of the physiological measures.

5. Correlations among the physiological indices themselves were not significant except for a negative correlation between GSR and pulse rate.

The major conclusion of the study is a negative one: Anxiety cannot be considered as a single phenomenon. Not only do clinical, performance and physiological measures fail to show correspondence with each other, but the physiological measures themselves are not interrelated in an expected fashion. Using the measures employed in this study we cannot predict how any individual will react relative to another individual in a group of normal subjects. Although there are indications of differences in physiological response patterns between expressors and repressors, the data do not provide evidence as to the specific nature of these patterns.

We can, however, state that an increase in external stress leads to decrement in performance and a rise in pulse rate and GSR, despite the sometimes negative correlation between these latter two physiological variables. The best predictive measure of a subject's anxiety, in any generalized sense, would seem to be provided by knowledge of the external stress in the situation.

85 pages. $1.06. MicA 55-1186

PSYCHOLOGY, EXPERIMENTAL

THE RELATIONSHIP OF MANIFEST ANXIETY MEASURES TO PERFORMANCE ON PERCEPTUAL SPEED TESTS

(Publication No. 11,556)

Matthew William Buttiglieri, Ph.D.
Washington University, 1955

Chairman: Philip H. DuBois

In a number of recent studies manifest anxiety has been conceptualized as an irrelevant drive which in some instances facilitates and in other instances disrupts performance. This study is concerned with this general area of investigation.

Manifest anxiety measures were obtained on a heterogeneous group of VA male patients with normal color vision who were hospitalized for reasons other than for organic brain damage. The anxiety measures included two self-rating scales, the Manifest Anxiety Scale and the Saslow Screening Inventory; and clinical ratings of manifest anxiety.

A series of perceptual speed tests which vary in difficulty because of neutral, compatible, and incompatible combinations of verbal, form, and color stimuli was also administered. The measure of performance was the time taken to read or name 128 items in each of the 12 different tests.

The purpose of the study was to investigate the relationships among these measures of manifest anxiety, the relationship between manifest anxiety and test complexity, and to determine the usefulness of manifest anxiety measures in a psychiatric hospital setting.

An intercorrelational matrix of anxiety measures disclosed high significant correlations between the self-rating scales. The correlations which range from .50 to .60 are significant well beyond the 1% level of significance.

High significant correlations were found between the clinical ratings made by the ward psychiatrist, the ward psychologist, and the experimenter. These correlations range from .34 to .48 and are likewise significant beyond the 1% level of confidence.

Correlations between the sum of the clinical ratings on the one hand and the self-ratings on the other were lower (Ratings vs. MAS = .27; Ratings vs Saslow = .10). Further analysis suggested some contamination of clinical ratings of manifest anxiety by estimates of latent anxiety, particularly in psychotic patients.

Manifest Anxiety Scale scores were not significantly correlated with age, educational level, occupational level, or intelligence measures with one exception. A positive correlation, significant at the 5% level, suggests that high anxiety in subjects tends to be associated with high scores on the Wechsler-Bellevue Block Design Test.

Correlations between manifest anxiety as measured by the MAS and performance on each of the perceptual speed tests with the effect of intelligence partialled out were in no individual case significant. However, intertest trends appear which suggest confirmation of the hypotheses that high anxiety is associated with faster performance on the easy tests and slower performance on the difficult tests.

Cases were ranked by MAS scores and the upper, median, and lowest 20 percent of the distribution were selected to comprise the high anxiety, median anxiety, and low anxiety groups. Results from analysis of variance indicate that there were no significant differences among the groups on age, educational level, occupational level or intelligence. No significant linear or curvilinear relationship was found between level of anxiety and performance on any of the perceptual speed tests.

Comparison of the Manifest Anxiety Scale scores of psychotic, neurotic, and medically ill subjects indicated that the MAS could be used effectively in distinguishing between only the medical and the neurotic groups. It was suggested that psychotic patients are so unpredictable and so variable in performance as to obscure relationships. Limitations exist in the usefulness not only of the MAS but in the concept of manifest anxiety with a hospitalized population, particularly when this population includes psychotic patients. 59 pages. $1.00. MicA 55-1187

THE EFFECTS OF CERTAIN TYROSINE DERIVATIVES ON MAZE PERFORMANCE AND ACTIVITY LEVEL OF THE WHITE RAT

(Publication No. 11,471)

Elizabeth Hammond Faulk, Ph.D.
The University of Florida, 1955

Two experiments were carried out in this study to assess the effects of phenylalanine deprivation (and hence certain tyrosine derivatives – namely, OHPPA and thyroxine) on psychological functioning.

Fourteen albino rats were divided into five diet groups including incomplete, supplementary thyroxine, supplementary OHPPA, supplementary OHPPA and thyroxine, and complete and tested on the Lashley Maze III. By inspection of means the complete, OHPPA, and OHPPA-thyroxine groups appeared similar to each other and were faster and more accurate in learning time and errors than the incomplete diet group.

The second experiment employed forty-one albino rats matched for age, sex, weight, and strain. Three diet treatments, incomplete, OHPPA, and complete, were tested in the Lashley Maze III, Spaeth Activity Wheel, and on an elevated version of the Stone Multiple T Maze. In most cases the OHPPA and complete diet groups, though not significantly different from each other, were significantly better than the incomplete group both in time, error, and trials to mastery on the mazes and in higher activity levels in the wheels.

OHPPA is concluded to be an effective variable in the level of nervous system functioning as manifested in the learning of two mazes and in the differences in activity level.

Several suggestions for further research are made, particularly studies of the psychological effects of OHPPA injections on mental defectives paralleling the work previously done on cretins with thyroxine.

85 pages. $1.06. MicA 55-1188

ANXIETY AND ATTITUDE AS VARIABLES AFFECTING PERCEPTION OF PERSONS

(Publication No. 11,513)

Joe Kamenetzky, Ph.D.
University of Illinois, 1955

This paper is concerned with two organismic variables – anxiety and attitude – as they affect the way in which one person evaluates another person. From several theoretical points of view, and from related experimental work in both physical and social perception, we are led to predict that anxiety will have the effect of making evaluations of persons more extreme. Moreover, we predicted that subjects' evaluations of an individual who is a member of a given class of persons will covary with the subjects' scores on an attitude scale whose content-referent involves that particular class.

Procedure: Ninety-six college students (48 males, 48 females) served as subjects. Half were extremely pro-labor and half were extremely anti-labor, as determined by a questionnaire on Attitude toward Labor. Each subject, tested individually, received five minutes of ambiguous, tape recorded information on each of two fictitious people called Mr. B. and Mr. R. For half the subjects, Mr. B. was identified as a management executive and Mr. R. was identified as a union official. For the other half of the subjects, the occupational identifications were reversed. Subjects were instructed to note their own likes and dislikes of these persons as they received the information. Following the presentation of this information, each subject was asked to list the first (male) friend and the first (male) person not particularly liked that he could think of.

Half the subjects were then placed under stress conditions which consisted of all of the following: anticipation of shock or taking a blood sample, increased formality on part of the experimenter, brief and intermittent use of bright lights and camera, and shift from pleasant to threatening surroundings. All other subjects were tested under more pleasant conditions.

Under their assigned stress or no-stress conditions, subjects rated the following six people on 28 traits and adjectives: (1) Mr. B.; (2) Mr. R.; (3) the announcer who described Mr. B. and Mr. R.; (4) the friend; (5) the person not liked; and (6) a person who tape recorded a one-minute excerpt of neutral material.

Two indices of anxiety were obtained from each subject: a self-rating of anxiety and a palmar sweating measure.

Results: 1. Whereas the stress and no-stress groups differed significantly in the amount of palmar sweating, the differences in respect to the self-ratings of anxiety were not significant.

2. The 28 rating scale items were divided into two highly internally consistent clusters, the valuative (favorableness) and the activity-potency. Both extremeness scores and raw scores were computed for each person each subject rated.

3. Comparison of pro-labor and anti-labor groups indicated that male subjects, though not female subjects, were consistently and significantly influenced by the labor or management label attached to the person described. The dependent variable was the valuative raw scores.

4. When the stress groups were compared with the no-stress groups, it was found that males placed under stress rated only person (5) significantly more extremely than no-stress males. Stress females rated persons (1), (2), and (5) significantly more extremely than no-stress females. The dependent variable was the valuative extremeness scores. No clear-cut differences were found on the activity-potency dimension.

5. Confounding variables, introduced extra-experimentally, make the results regarding persons (3) and (6) uninterpretable.

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Discussion: Reasons for the sex differences in respect to both variables were discussed, theoretical and methodological implications of this study were elaborated, and suggestions for future research were outlined. 195 pages. $2.44. MicA 55-1189

RETINAL SUMMATION AND INHIBITION

(Publication No. 11,419)

Saul Martin Luria, Ph.D.
University of Pennsylvania, 1955

Supervisor: William A. Shaw

Graham and Granit found that the cff of a light is depressed in the presence of a brighter light. They demonstrated this phenomenon of "retinal inhibition" in the fovea but could not obtain it in the periphery. They concluded that inhibition was a foveal property and would account for the high visual acuity in the fovea since the inhibition could counteract the summation effects. They advanced a theory that the inhibition was the result of activity by the system of amacrine cells in the retina. Subsequent studies indicated the phenomenon might not be limited to the fovea.

In this paper, a new explanation of the phenomenon was formulated dealing with cell populations, cell densities, etc., along the lines of Crozier's theory. Retinal summation was postulated as the basis of the inhibition phenomenon whose existence was then predicted in the periphery.

In the experiment, Graham and Granit's foveal conditions were duplicated, but in the periphery, a much greater separation between the two lights was used. Eight subjects were tested and the inhibition phenomenon was demonstrated for all subjects both in the fovea and the periphery.

32 pages. $1.00. MicA 55-1190

A STUDY OF GENERALIZATION AND EXTINCTION IN EYELID CONDITIONING TO PURE TONE AUDITORY STIMULI

(Publication No. 11,599)

Donald Francis Maietta, Ph.D.
University of Pittsburgh, 1955

The eyeblink responses of 54 adult subjects with normal hearing were conditioned to a 1000-cycle tone at 40 decibels of intensity. The unconditioned stimulus was an air puff delivered to the right eye of each subject. The unreinforced eyeblink response was analyzed for resistance to extinction to three varying tones at three varying decibel intensities.

The latency of a subject's eyeblink response to first association of tone-air puff in the conditioning schedule, as recorded on chart paper by an inkwriter, chiefly determined the criteria for acceptable conditioned responses. Fifty per cent reinforcement was used in the conditioning schedule. Randomized tones, air puffs, and tone controls automatically were presented for conditioning and extinction trials.

The specific questions asked in this investigation were:

1. Can an eyeblink response to a pure tone auditory stimulus conditioned with air puff be distinguished from chance eyeblink responses?

2. Will resistance to extinction of the conditioned eyeblink response to a pure tone auditory stimulus be affected if the intensity and frequency of the tone are varied or are kept constant in extinction?

The null hypothesis upon which the first question was based is that conditioned eyeblink responses and chance responses to audible tone were drawn from the same population.

The hypothesis upon which the second question was based is that the number of eyeblink responses to extinction of the conditioned stimulus and the number of eyeblink responses to extinction of the other frequencies and intensities are drawn from the same population.

The five per cent level was accepted as the minimum confidence level for rejection of the null hypotheses stated.

The t test statistical technique was used to test the null hypothesis in the first question. Significant differences greater than the one per cent level of confidence supported the conditioned eyelid responses to audible tone as representative of a different population than chance responses to controls for each of three blocks of 10 tone presentations selected from the conditioning and extinction schedules. The null hypothesis was rejected.

The results of blink response resistance to extinction did not furnish a basis for rejecting the null hypothesis stated in the second question. The f ratio of variance statistical technique was not significant for analyses of variance applied to nine extinction groups presented with varying intensities and tones. The null hypothesis stated in the second question was tenable, and any blink response differential effects among the tones and intensities important in hearing reception can be considered the result of sampling variation.

The findings of this investigation would justify further refinement of this procedure as a possible test of hearing measurement.

145 pages. $1.81. MicA 55-1191

THE RELATION OF OVERT ERRORS DURING LEARNING TO TRANSFER AND RETROACTIVE INHIBITION

(Publication No. 11,567)

Mary Adell Morrow, Ph.D.
Washington University, 1954

Chairman: Marion E. Bunch

Overt intrusions have played a major role in attempts to account for retroactive inhibition. The present study was designed to investigate the source of overt errors in paired-associate learning, and their relation to retroactive inhibition.

The design of the experiment followed the usual transfer and retroaction paradigms, and was replicated in three major groups. The three groups, to which 270 subjects were assigned at random, were given instructions of the following type: (1) to inhibit overt errors (2) to give overt errors freely (3) no instructions concerning overt errors. The materials were two lists of paired-associate nonsense syllables, one administered as an initial learning task, and the other as an interpolated task. They were learned under conditions believed to favor negative transfer and retroactive inhibition.

The instructions produced marked differences in the frequency of overt errors given by the 3 groups in original and interpolated learning, and in recall and relearning of the original task. These errors, however, did not produce group differences in rate of learning in terms of trials of the initial and interpolated tasks. When errors on the initial task were equated by analysis of covariance, the Inhibited group showed fewer errors on the interpolated task than the other two instruction groups. The same is true when trials on the initial task are controlled. When each experimental group was compared with its' appropriate transfer control group in trials to learn the second task, it was found that the Inhibited and Free groups showed positive transfer to the interpolated task, while the Control group showed neither significant positive nor negative transfer.

In regard to classification of types of errors in original and interpolated learning, it was found that the Inhibited group gave almost no overt errors. The Free group showed the greatest proportion of overt errors in comparison with the other two instruction groups. The Free group also gave the greatest number of overt intrusions from the original to the interpolated list. In the Free and Control groups it was found that without exception the overt intrusions given in interpolated learning were among the correct responses given in the criterial trial of original learning.

Retroactive inhibition measured at recall and relearning of the original list was found to be considerable in amount, and approximately equal, for all three experimental groups. The greatest number of overt intrusions from the interpolated list to the recall and relearning of the original list was given by the Free instruction group.

The overt intrusions given in recall and relearning of the original list by the Free and Control groups were responses from the interpolated list which had been learned to the criterion.

In recall the correct responses given by all groups were among those which had been originally learned to the criterion. In the Free and Control groups these were also the same original list responses which had appeared as overt intrusions during interpolated learning. In relearning, all subjects relearned the same responses which had been originally learned to the criterion. 102 pages. $1.28. MicA 55-1192

A TEST OF INTERFERENCE VS DRIVE INCREMENT THEORY OF THE INFLUENCE OF ANXIETY UPON LEARNING

(Publication No. 11,427)

William M. Nicholson, Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. Seymour Feshbach

It was the purpose of the present study to consider alternative hypotheses derived from two theories which deal with the influence of anxiety upon learning. The essential difference between the two theories might be summarized as follows:

> The Iowa group accounts for the influence of anxiety on performance by the augmentation of the reaction potential produced by the drive properties of anxiety.
>
> Mandler and Sarason account for the influence of anxiety upon performance by the responses which are elicited by anxiety as a drive-stimulus.
>
> According to the Iowa theory, anxiety in a subject who was not previously anxious would increase the reaction potential of all responses. According to Mandler and Sarason, anxiety elicits responses not previously present in the situation.

From the Mandler and Sarason theory it was predicted that high scorers would decrease in correct anticipations under ego orientation, and the low scorers would increase in the number of correct anticipations.

Subjects were picked from the upper and lower deciles of the Taylor Anxiety Scale. The high scorers and low scorers were assigned randomly to either an easy or hard task under either task or ego orienting conditions. The tasks were two lists of 12 nonsense syllables which the subjects were to learn serially. The dependent variable was the number of correct anticipations per trial. An analysis was also made of the frequencies of the types of errors made under each condition.

The following results were obtained:

1. Under task orientation, the high scorers performed essentially the same on both tasks as the low scorers in regard to correct anticipations. Under ego

orientation, the high scorers gave fewer correct anticipations on both tasks than when task oriented. The low scorers gave more correct anticipations than when task oriented. This interaction was significant at the .05 level.

2. Fluctuations in errors were mainly reflected in "new syllables" and "no response errors," rather than "out-of-place errors." The "no response errors" were presumed to be indicative of defensive reactions, whereas the "out-of-place errors" were presumed to be more closely related to intraserial interference.

The interaction between anxiety and instructions supports the Mandler and Sarason theory. The failure to obtain an increase in performance of the high scorers under ego orientation on the easy list and the failure to obtain a decrease in performance of the low scorers under ego orientation on the hard list is incompatible with the Iowa theory, but supports the theory of Mandler and Sarason. The constancy of the "out-of-place errors" also weakens the viewpoint taken by the Iowa group. Thus, the experimental results are consistent with the theory of Mandler and Sarason, and in several instances are incompatible with the Iowa theory. Impairment in performance produced by anxiety is not a simple matter of augmentation of all responses by the increased effective drive. Instead, it is necessary to take into account that anxiety may elicit responses which are not elicited by other stimuli in the situation. These responses to anxiety may compete with correct responses and impair performance.

47 pages. $1.00. MicA 55-1193

THE EFFECTS OF NEONATAL ANOXIA UPON THE LEARNING OF RATS AT MATURITY

(Publication No. 11,576)

Carson Young Nolan, Ph.D.
Washington University, 1953

Chairman: Marion E. Bunch

The purpose of this study was to determine the effect of oxygen deprivation immediately following birth upon the learning ability of rats at maturity. Fifty-seven of 111 littermates were subjected to an environment of 5% equivalent oxygen for a one-half hour period following birth. At approximately 70 days of age all 111 animals learned to run a Stone-type water maze to a criterion of one perfect trial. Thirty days after reaching this criterion, all animals were required to relearn the maze to the same criterion. Shortly after completing the relearning trials, 33 of the animals were given 30 rewarded bar pressing responses in a Skinner Box on each of three consecutive days. The response was then extinguished by subjecting the animal to a 20-minute non-reward period in the apparatus until a criterion of 5 or less responses per 20-minute period was reached.

No difference existed between anoxic and normal animals in ability to learn the maze, in ability to relearn the maze after 30 days, or in ability to resist extinction of a bar pressing response. It is suggested that two factors may be responsible for lack of positive results: (1) the small amount of deprivation, and (2) the extreme physiological immaturity of rats at birth. This suggestion is supported by a review of the results of recent studies.

56 pages. $1.00. MicA 55-1194

THE RELATION OF INTESTINAL ABSORPTION STATES TO THE INHIBITORY EFFECT OF HYDRATION UPON THE RUNNING BEHAVIOR OF THE WHITE RAT

(Publication No. 11,543)

Andrew Kasmer Solarz, Ph.D.
University of Illinois, 1955

Eighty male albino rats were placed on 24 hours water deprivation and trained for 12 days to run a straight 12 foot runway. At the end of this period they were randomly assigned into 4 experimental subgroups and 4 control subgroups. During the next 5 testing days, the experimental (E) animals were loaded with 75% of their daily average water intake prior to being given a trial on the runway. The E. subgroups, of 10 animals each, were given either a 5, 10, 15, or 30 minute delay following the load before being run. The C. subgroups were treated similarly save that they were only catheterized and not given the H_2O load. Performance was measured in terms of speed of running through each third of the runway and amount of H_2O consumed in the goal box.

Following the testing period in the runway, the experimental animals were loaded again, given their delay periods, and now, sacrificed in order to determine the course of the water load through and out of the gut, through time. The rate of water passage out of the stomach, and rate of absorption, was determined, and correlated with performance.

The following results were obtained: 1. There is a slight negative effect upon running performance at 5 and 10 minutes following the H_2O load. 2. A major decrement in running performance appears at 15 minutes and persists through 30 minutes. 3. There is a slight negative effect upon drinking performance at 5 minutes following the H_2O load. 4. A major decrement in drinking performance appears at 10 minutes and persists through 30 minutes following the load. 5. The water load leaves the stomach at a constant ratio with respect to the amount of water in the stomach; after an initial higher rate for the first five minutes. 6. Absorption from the gut proceeds in a negatively accelerated fashion. The rate increases for the first 10 minutes following the load, and then remains stable for the last 15 minutes of the 30 minute period. 7. The full 75% load has not been absorbed at the end of 30 minutes. 8. Each of the E. subgroups shows a positively accelerated approach in running to the goal box, but does not demonstrate the typical "slowing up" just prior to it. The typical

"goal gradient" is demonstrated in the control group running.

The historical background of the problem of water regulation is presented, and the results of the present investigation are analyzed and discussed in the light of past studies. Several new hypotheses are suggested in order to integrate the facts resulting from this experiment. Problems for future research are briefly discussed.

64 pages. $1.00. MicA 55-1195

A STUDY OF "EXTERNALIZATION" OF DRINKING BEHAVIOR IN RATS

(Publication No. 11,440)

Charles Alfred Thomas, Jr., Ph.D.
University of Pennsylvania, 1955

Supervisor: Dr. Francis W. Irwin

The purpose of this experiment was to determine if neutral external stimuli would acquire the capacity to elicit drinking behavior as a function of the frequency and consistency with which they were associated with thirty drive-reduction, as postulated by Anderson, Hull, and Miller. Two groups of rats were given water 30 times in special environmental situations only, under 12-hour water deprivation. An Experimental group received water in the same environment 30 times while a Control group drank in 11 different environments over the 30-trial period. Following this training period the groups were compared with respect to drinking activity under the conditions of the training period and under minimal water deprivation.

It was found that the Experimental group consistently drank more water than the Control group over the later training trials, in accord with the positions of Anderson, Hull, and Miller. Since an independent measure of drive was not obtained, however, it cannot be concluded that drive learning occurred.

On the satiation trial the Experimental group did not exceed the Control group in amount of water consumed. This result is not in accord with the externalization principle which would predict that the Experimental group would exceed the Control group.

40 pages. $1.00. MicA 55-1196

KIERKEGAARD AND NORWAY: A STUDY IN "INWARDNESS" IN HISTORY WITH ILLUSTRATIVE EXAMPLES FROM RELIGION, LITERATURE, AND PHILOSOPHY

(Publication No. 11,452)

Haakon Flottorp, Ph. D.
Columbia University, 1955

The untutored bonde, revivalist preacher, and author, Hans Nielsen Hauge (1771-1824) preconditioned Norway for an influence from Søren Kierkegaard. Hauge received his "call" through a mystical experience (April 5, 1796) of a non-cognitive nature – its noëtic content being furnished by the Bible in a Lutheran "existential" interpretation, with Pietistic and mystical elements from Erik Pontoppidan and Johann Tauler, and others. Due to his invectives against the clergy of the established church, and his economic enterprises, which tended to break up the economic and social structures of eighteenth century Norway, he was persecuted and imprisoned. All this was historically conditioned, but at the same time it happened as acts of freedom and part of Hauge's religious calling. For Hauge's encounter with God established a freedom which had to be reaffirmed continuously in a spirit of duty and faith, without any pragmatic or rational criteria of truth. What Kierkegaard later put into writing as a Training in Christianity, Hauge, as a follower of Christ (imitatie Christi in Lutheran interpretation) had made real to his Norwegian contemporaries.

The Theology Professor Gisle Johnson (1822-1894) carried the revival into the emerging Norwegian bourgeoisie, helped by Kierkegaard's writings, which at that time (1851) were well known in Norway. He introduced a peculiar theological epistemology, a "Pistics" as a separate section of Christian Dogmatics. Since the Christian faith "has come into the world" it cannot be "understood," except in its "becoming," in its "real genesis" (J. T. Beck). For this purpose, Johnson goes beyond his theological teachers Harless, Thomasius, Beck, and von Hofmann, employing Kierkegaard's "stages" in order to understand the Christian faith "in its becoming" through the three possible forms of human existence: Man's God-relationship within immediacy, under the law, and in faith. But Johnson has not grasped the philosophical implications of Kierkegaard's thought; with the "Erlangen School" of theology he assumes that faith institutes a new immediacy of a cognitive nature. To Hauge, faith was an act of freedom, but Johnson will understand faith "in its necessity."

The dramatist Henrik Ibsen (1826-1906) was called "Kierkegaard's poet" but protested this label by declaring: "Of Kierkegaard I have read little and understood less." The riddle of this contradiction is solved, in part, through an analysis of his earliest production, where a pattern can be discerned which is similar to that found in his later, "Kierkegaardian" plays. This pattern is typically Romantic, with features borrowed from Hegel and Heiberg, but also from Kierkegaard, but the Kierkegaardian elements are employed in a very un-Kierkegaardian way. Ibsen confounds Kierkegaard's stages, understanding religious and ethical existence from the standpoint of the aesthete ("On the Fells," Love's Comedy, Brand). Isben finds his reality in his creative production, and his "Realism" leads him away from an existential concept of freedom (cf. Freud's theory of the introvert artist).

Marcus Jacob Monrad was Professor of Philosophy at the University in Oslo during almost fifty years (1845-1891). – To Monrad, the dissention within the Hegelian school proves the significance of Hegel's thought, for the subject matter of philosophy is the responses of individual, historically conditioned thinkers to that "objective" truth which gradually reveals itself through their discussions. Kierkegaard's individualistic truth, his "subjectivity" as "truth" is only an extreme point in the development of faith reflecting upon itself; it is faith doubly reflected. And it is impossible to remain at this "point." The Kierkegaardian believer cannot exist. Monrad remained a Hegelian, but he rejected the closed system. 345 pages. $4.31. Mic 55-119

ALEXANDER CAMPBELL'S CONTROVERSY WITH THE BAPTISTS

(Publication No. 11,603)

Thomas Elmer Pletcher, Ph. D.
University of Pittsburgh, 1955

The purpose of this investigation is to survey and portray the religious conflict between Alexander Campbell and the Baptists in so far as that conflict is recorded in the literature of the period from 1816, when Campbell preached his famous "Sermon on the Law," to 1866, the time of his death.

The report is presented in 12 chapters. An early section is devoted to historical backgrounds and includes a statement concerning early nineteenth-century conditions in America, origins of the Baptists and the Disciples of Christ, union and fellowship of the bodies, controversy in the literature, and the final separation of the two groups. Some chapters deal with outstanding elements of contention, some with minor dissents, and others with minor issues which became points of great bitterness. An investigation of these reveals how real doctrinal differences

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

were sometimes obscured in a maze of prejudice and confusion. One must see the complete picture with its coloring of suspicion, misunderstanding, and fear before he is in a position to evaluate and understand.

The phases of the controversy treated in detail, each constituting a section of the report, are: The Covenants; The Name; The Christian Union Platform; The Creeds; The Christian Ministry; The Communion; Christian Experience; The Influence of the Holy Spirit; and The Design of Christian Baptism. A final chapter summarizes the author's findings and outlines his principal conclusions.

Numerous religious periodicals from Reformer and Baptist sources appeared during the period surveyed, and an enormous amount of literature was published concerning the controversy, with Campbell leading the production. The furor caused important and insignificant issues to be commingled. Time had to elapse before the major differences emerged above the minor. Garbling apparently played an important role. Many accusations of misrepresentation and deletion were hurled by Campbell at the Baptists and vice versa. The controversy took its toll in individual venom and loss of church prestige. Personal abuse was appalling. Campbell's early bitter attacks on the clergy not only hurt Baptist ministers and made it more difficult for those attempting an improvement of the clergy, but also worked a hardship on the later ministry of the Reformers. His early denunciations retarded common religious practices of various denominations. The missionary cause especially suffered for many years because of his early opposition. Reversal from attack to support of cherished Baptist customs intensified Baptist opposition.

Campbell stimulated the Baptists to do some much-needed reforming, helped give reason an honorable place in theological discussion and alerted people to the call of Christian union. While he was generally contemptuous of the Baptist clergy, there were Baptist ministers of intellectual stature with whom Campbell had to reckon. Debates with such leaders no doubt sharpened his thinking and modified some of his doctrinal views. Baptists often embarrassed the Reformers by demanding that the superior fruits of the current reformation be demonstrated, and by calling attention to defections within the Reformer ranks.

In the light of the present study, the writer is of the opinion that much of the unwillingness for union from minor groups within both bodies stems from a misconception of each other's doctrinal beliefs. Minor issues have disappeared and former major differences now appear as minor. There are other reasons responsible for the separation, but theological issues should no longer be regarded as major factors in keeping these two great religious bodies apart.

413 pages. $5.16. MicA 55-1197

SOME PERSONALITY CORRELATES OF RELIGIOUS ATTITUDE AND BELIEF

(Publication No. 11,466)

James Gilmour Ranck, Ph. D.
Columbia University, 1955

For abstract see Psychology, page 878.

172 pages. $2.15. Mic 55-117

THE CONTENT OF PRE-MARITAL INSTRUCTION BY 134 PROTESTANT CLERGYMEN

(Publication No. 11,607)

Francis G. Stewart, Ph. D.
University of Pittsburgh, 1955

This study was undertaken to determine the principal content of pre-marital interviews conducted by a selected group of Protestant Ministers, to ascertain what young people who have been married by these ministers consider to be important content in instruction for marriage, to learn the couples' opinions concerning what they received, and to suggest some implications of the findings.

An outline of content for college classes in pre-marital education prepared by Laura W. Drummond was used as a checklist. A personal data sheet, a pre-marital counseling program questionnaire, and space for suggestions, comments, and the names of couples to participate were added to complete the instrument. The results of a pilot study with 13 ministers and 63 couples in the Pittsburgh area were used in perfecting the instrument which was then mailed to 489 ministers and 279 counselees. The ministers' names were furnished by Family Life Publications, Inc., Chapel Hill, North Carolina, and were selected from a larger list of clergymen who had shown interest in pre-marital instruction by having procured the "Sex Knowledge Inventory" as a tool in this kind of program. The couples' names were given by 34 of the ministers who returned the questionnaires. One hundred eighty-two replies, including 134 returned questionnaires, were received from the ministers. Forty-four counselees replied, representing 15 ministers.

The clergymen and couples were from scattered geographical areas and represented various income groups and many denominations. The ministers' preparation for pre-marital counseling was varied and they used many methods in their work.

The ministers marked the check list to identify those subjects which they usually included in their pre-marital interviews and those which they occasionally included. The young people marked the check list to identify those subjects which they received from their ministers and those which they believed should have been recieved.

The replies of each group were tabulated separately. The responses of the couples were then

studied in connection with those of the ministers who married them. In this tabulation a positive correlation (r = + .74) was found to exist between what the ministers reported they usually gave to their couples and what the couples reported they received from them. This indicates a high degree of accuracy in reporting on the part of both groups and a considerable retention of information by the young people.

Content was the central emphasis in a majority of the interviews. The most popular method of counseling was "factual, giving of information" but there was also some use of client-centered techniques. Of the seven topics most often presented, three were in the area of "sex," and one each in the areas of "religion and ethics," "family economics," "pre-marriage problems," and "two and three generation adjustments." The young people expressed the desire to receive more information than had been given them in all areas except "sex."

The ministers apparently need more academic and clinical training for their work of pre-marital counseling. Much instruction customarily given at this time could be more wisely offered in pre-marital and post-marital classes. This approach would reduce the amount of content necessary to be included in pre-marital interviews, thereby permitting a greater client-centered emphasis. There should be an increased use of referral agencies, but the pastor should never relinquish to others the privilege of interpreting the whole of life in the light of his spiritual understanding and faith. The couples' requests for more information in pre-marital instruction is a challenge to those conducting these interviews.

138 pages. $1.73. MicA 55-1198

SOCIAL PSYCHOLOGY

VOCATIONAL PLANNING AND REHOSPITALIZATION OF SCHIZOPHRENIC PATIENTS

(Publication No. 11,450)

Leon Cohen, Ph. D.
Columbia University, 1955

Mental patients occupy over half a million hospital beds in the United States, more than those occupied by all other hospital patients combined. The tremendous cost in lives and money which this type of illness imposes upon society has in recent years caused a focusing of attention upon its control.

For mental disease, rehospitalization represents one major area in which efforts at control may be exercised. In the United States approximately 200,000 patients leave mental hospitals each year and between 30% to 50% of these return. In New York State one-third of all admissions to mental hospitals in 1947 were readmissions. It is with this problem of rehospitalization that the present study is concerned.

That the life situation in which the ex-patient finds himself may be decisive in determining whether or not he will require rehospitalization has long been recognized by social workers to whom responsibility for ex-patients has been traditionally delegated. Pre-departure planning has evolved as a major contribution of the social worker to reducing the likelihood of rehospitalization.

Employment represents a major segment of community life and social workers have recognized the difficulties of vocational adjustment as a major stumbling block to the successful social adjustment of ex-patients. As a result it is coming to be accepted by those with responsibility for discharging mental patients that the patients should have some vocational plans at the time of departure from the hospital.

It was the purpose of this study to test the hypothesis that patients with more crystallized vocational plans at the time of departure from the hospital have a better chance of remaining out of the hospital than those with less crystallized plans.

Patients leaving a Veterans Administration neuropsychiatric hospital during the two year period ending eighteen months prior to the commencement of the study served as the population examined. All patients satisfying the following four criteria were selected: 1. Diagnosis of "Schizophrenic reaction, chronic, severe." 2. Departed from hospital on "Trial Visit" status. 3. Were World War II veterans. 4. Were rated as being trainable for employment at time of departure.

The two year period yielded 114 patients who satisfied these criteria. These 114 patients comprised the population studied. This group was divided into those who required rehospitalization within 18 months of departure from the hospital and those who did not. Each case was further classified regarding the degree of crystallization of his vocational plans at the time of his departure from the hospital. Abstracts of the "Pre-Trial Visit Report" of the Social Service Department served as the basis for this classification. Three categories of crystallization were established as follows: 1. Patient had a job awaiting him upon leaving the hospital. 2. Patient knew the type of work which he planned to seek upon leaving the hospital. 3. Patient had neither job nor any idea as to the type of work in which he was interested. Two disinterested persons rated the abstracts for degree of crystallization as a check upon the reliability of the investigator's ratings.

In addition, the rating of each patient's "degree of incapacity" (essentially a rating of the severity of the patient's psychotic manifestations) at time of departure was noted as was whether or not he obtained

employment while out of the hospital. Data were also collected regarding the six biographical factors of (1) age; (2) number of hospitalizations; (3) total hospitalization; (4) length of last hospitalization; (5) education; and (6) marital status, so that the comparability of rehospitalized and non-rehospitalized groups for these factors could be determined.

Significance was tested by X^2 and Student's t, and accepted at the .05 level of confidence.

The major findings of the study were as follows:

1. Having a job to go to, and having a crystallized vocational plan, are both related to remaining out of the hospital.

2. No relationships were found between severity of pre-departure psychotic manifestations and re-hospitalization.

3. Those with pre-departure vocational plans tended to obtain employment more often than those without plans.

4. Those who obtained employment remained out of the hospital longer than those who did not obtain employment.

These findings support the practice of encouraging vocational planning on the part of mental patients preparing to leave the hospital. The results also suggest the desirability of providing patients with vocational counseling in order to facilitate effective job planning and job finding.

In a broader sense the findings support a growing trend toward viewing psychosis as a psycho-social phenomenon. 56 pages. $1.00. Mic 55-120

IMPRESSIONS OF PERSONALITY, AUTHORITARIANISM, AND THE FAIT ACCOMPLI EFFECT

(Publication No. 11,429)

Irving H. Paul, Ph. D.
University of Pennsylvania, 1955

Supervisor: Malcolm G. Preston

This is a study of people's impressions of the personalities of leader-figures who are engaged in a conspicuous and prominent leadership contest; of how these perceptions are affected on the one hand by the outcome of the contest and on the other hand by the person's own orientation to leaders and to leadership phenomena.

The study was executed in the setting of the 1952 United States presidential election. The major candidates Dwight D. Eisenhower and Adlai Stevenson were the stimulus-figures. Impressions were obtained by ratings, with regard to favorability or attractiveness, on a comprehensive set of personality-trait scales. The orientation to leadership of the subject was determined by his location along the dimension of the personality variable authoritarianism-versus-equalitarianism. An experimental population was selected from a volunteer pool of 320 undergraduates at the University of Pennsylvania. Four groups of 20 Ss comprised the experimental population and the selection was engineered so that two of the groups favored one candidate, the other 2 favored the second candidate. In each of these sets of 2 groups, one was composed of Ss who fell in the authoritarian tail of the A-E distribution and the second was composed of Ss who fell in the equalitarian tail. Ratings of both candidate-figures were obtained both one week prior to the election and two to three weeks subsequent to it – before and after the fait accompli.

The general theoretical position which guided the study contends that two major conditions decide the view we get of a person: a) his stimulus-properties or what we perceive of them, and b) the needs and claims that relate us to him. That is, the phenomena may be approached from two major vantage points: the perceptual and the motivational. Facts were developed in the present study which were intended to point up the way in which a central change in the stimulus-properties of the leader-figure (e. g. his successful acquisition of the role of President) in coordination with the motivation of the subject, both short-term (his endorsement-attitude) and long-term (his authoritarian or equalitarian personality make-up), may be implicated in the re-organization of impressions which the leader-figure evokes.

The present study was exploratory in nature. The basic expectation was that, across the election period, a change in the impression of personalities of the candidate-figures would take place. While it was proposed that this change would systematically relate to the fact of which is the winning and which the losing candidate, it was further proposed that the change would largely depend in turn on the subject's own attitudes and personality in terms of his orientation to authority and to leadership phenomena. It was further proposed that the change would be a perceptually or cognitively selective one, that is, the change would occur differentially for the various aspects or components of the impressions.

The results of this study permit the contention that, in a leadership-contest situation, a fait accompli effect with respect to impressions of the personalities of the implicated leader-figures has been demonstrated. The major expectations in the main find support in the findings. Impressions of the winner do increase, with respect to favorability of trait-ratings, at a rate which is greater than in the case of the loser and this differential increase appears more markedly in the case of the authoritarian Ss.

Since the fait accompli effect is one that primarily influences those persons whose initial stand or attitude was at variance with the outcome, it is noteworthy that the results of this study show that the differential increase in favor of the winner is greater for those Ss who initially opposed him. This finding too is more pronounced in the case of the authoritarian Ss.

The fait accompli effect proves to be a selective one and the increase in ratings appears to vary meaningfully across the various aspects of the impressions. For example, the greatest differential increase in favor of the winner occurs for the trait-class which was designed to refer to leadership strength. This finding too is more exaggerated for the authoritarians.

Finally, there are findings which point up the relationship between endorsement and impressions. Ratings of favored-candidates are clearly higher than ratings of nonfavored-candidates. Of some interest are the findings with respect to the discrepancies between S's rating of his favored and nonfavored leader-figure. These discrepancies are greater in the pre-election period than in the post-election period. Moreover, in both periods, the discrepancies are greater for the authoritarian Ss than for the equalitarians. This seems primarily due to the authoritarian's tendency to rate his nonfavored leader-figure low. 105 pages. $1.31. MicA 55-1199

COGNITIVE STRUCTURE AND COGNITIVE TUNING

(Publication No. 11,379)

Robert Boleslaw Zajonc, Ph. D.
University of Michigan, 1955

The purpose of these studies is to construct a theoretical system by means of which cognitive experiences of individuals can be rigorously described, and to demonstrate how this descriptive system can be empirically applied within broader theoretical frameworks.

In Part 1 are presented formal properties which reflect various structural dimensions of cognitive experiences. Such properties as the degree of differentiation, complexity, organization, unity, homogeneity, and segmentation are defined. The properties are constructed by means of a mathematical model, namely set theory. A measurement method which satisfies the theoretical and empirical requirements of the descriptive system is also presented. A validation study was conducted in which individuals who had different amounts of information about a given object were compared for the structure of their cognitive experiences, and it was discovered that the system is capable of discriminating among them with sufficient precision.

In Part 2 a theoretical extension is advanced to account for the formation, maintenance, and change of cognitive structures. The concept of "cognitive tuning" is used to account for the arousal of a particular cognitive structure in the individual's phenomenal experience. It is assumed that individuals "tune in" such cognitive structures when they anticipate dealing with information. Two basic types of dealing with information are distinguished: transmitting and receiving. Two corresponding types of cognitive tuning are defined: transmitting and receiving tuning. The former occurs when the individual anticipates transmitting information, the latter when he anticipates receiving information. It is postulated that these types of cognitive tuning lead to the arousal of different cognitive structures; transmitting tuning results in predominantly rigid and specific structures, whereas receiving tuning results in predominantly flexible and general structures.

Three studies were conducted to test the following derivations from the postulates: 1) Given equal initial information, cognitive structures arising under transmitting tuning will manifest higher differentiation, complexity, organization, unity, and lower homogeneity and segmentation, than structures arising under receiving tuning. 2) When information is received for future transmission it will be transformed into cognitive structures higher in differentiation, complexity, organization, unity and lower in homogeneity and segmentation, than a cognitive structure transformed from information received as basis for additional future information. 3) When individuals deal with information which is contrary to their knowledge or beliefs, cognitive structures formed from this information will show equal values on the descriptive properties, whether transmitting or receiving tuning is involved. Most of these hypotheses were confirmed, and it was also found that when individuals deal with contrary information, cognitive selectivity is radically heightened, thus considerably decreasing the degree of differentiation.

Direct evidence was obtained to demonstrate the usefulness of the descriptive scheme in treating relationships between cognitive variables and information, communication, and attitudes. Furthermore, indirect evidence was obtained to suggest possible future application of the scheme for the description of such phenomena as the self, life space, group, organizational and role structure. Finally, the results in the area of cognitive tuning indicate that this concept can become useful in problems dealing with selective perception, perceptual defense, recall, and rumor. 218 pages. $2.73. MicA 55-1200

SOCIOLOGY, GENERAL

POLITICAL CLEAVAGE WITHIN THE INTERNATIONAL TYPOGRAPHICAL UNION

(Publication No. 11,451)

James Samuel Coleman, Ph. D.
Columbia University, 1955

This is a case study of internal politics of a trade union which has a continuing two-party system. The study examines the history of political issues within the union, the voting records of locals in international elections and of shops within locals, and the voting behavior of a sample of members of the New York local. Throughout the study, the intent is to locate (a) the sources of political cleavage, particularly those related to the social and economic structure of the union, but including background differences among the men; (b) the dynamics of cleavage, including the problem of how a potential issue builds up to become an actual issue, and the factors which facilitate or inhibit this, and the problem of the socio-psychological processes which occur during the election campaign, leading men to vote in one direction or another.

The intent of the thesis is to use this "deviant case" among trade unions, deviant in the sense that it has a continuing two-party political system, to provide insight into the problems of democracy in organizational governments, and more generally insight into the various relations between the social structure of an organization and its internal politics.

The continuing basis of division between the parties has been generally a militant-conservative split, although issues of economic interest, of the "ins vs. outs," and of personal politics have played some role in the internal dispute. The union began as a federation of large locals, and with a membership fairly well divided in their approach to unionism. These factors, initially favoring democracy in the union, have continued to the present.

The role of large locals in serving as bases of organization and communication is shown by an analysis of their voting behavior since 1900 and by examination of particular events in the history of union politics. The orientations of the party leaders in the New York union are examined through the use of interviews, and the background factors which make a man vote as he does are examined. Finally, the social context of a man's shop, his friends, his shop steward, and his own values are examined for their effect on his voting behavior and on the processes of conversion which occur during the campaign.

Generalizations from the analysis are developed, concerning the effect of an organization's economic structure, its social structure, and the type of men it recruits on the nature of its internal politics. The social sources of "mediating" and "instrumental" governments are examined, and the political consequences of each are discussed. The social psychology of voting behavior is examined on the basis of the analysis, and a general approach to the study of voting behavior is suggested. An appendix discusses methodological problems involved in a single case analysis of an organization, presents a general statement concerning the usefulness of statistical tests of significance in analyses like this one, and includes the interview schedule used in the study.

394 pages. $4.93. Mic 55-121

SOCIAL PARTICIPATION AS A FACTOR IN CHURCH GROWTH

(Publication No. 11,572)

Robert George Schmidt, Ph. D.
Washington University, 1955

Chairman: David B. Carpenter

The purpose of this study was to determine whether there was a relationship between the growth of an institution, as indicated by the growth or decline of Methodist Churches in St. Louis and St. Louis County, and selected characteristics of the persons associated with those institutions. The characteristics investigated were six types of social participation, schooling, age, occupation and residential mobility.

A schedule was developed to secure the necessary information. This schedule was submitted by personal interviewing to a one per cent sample of the congregations of thirty-nine of the forty-two churches in the St. Louis District of the Methodist Church. A total of 179 persons were interviewed.

Six social participation scales were developed from the data secured in the interviews. These scales were validated by establishing internal consistency through the Guttman technique of scale analysis. Utilizing correlation and contingency methods, and by determining the significance of difference between means, the association was determined for the variables concerned.

It was concluded that the growth of an institution was not directly related to the personal characteristics selected for this study. Instead, church growth appeared to be related significantly to the growth of population in the areas in which the churches were located. Social participation with relatives, neighbors

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and friends, which were associated with church growth, appeared to be affected significantly by the factor of age. The areas with growing populations are being settled by persons in the younger age brackets. These persons evince interests in affiliating with, or maintaining affiliations with a church, as well as participating with their neighbors, friends and relatives. Hence, the positive relationships found between church growth and participation with neighbors, friends, and relatives.

117 pages. $1.46. MicA 55-1201

PROCESSES OF ORGANIZATION

(Publication No. 11,372)

Robert Stuart Weiss, Ph. D.
University of Michigan, 1955

This study examines the structure of a government organization and the functional contributions of its members, in an effort to shed light on processes which are important to the organization's continued operation. The processes considered are: (1) processes of coordination, which have to do with the integration of the contributions of members of the organization; (2) processes of allocation, which have to do with the assignment of responsibility for particular tasks to particular individuals; and (3) processes of adaptation, which have to do with the way in which individuals accept the tasks allocated to them.

An organization is conceived of as a system of activities each contributed by individual members of the organization, where the total system is oriented to the achievement of certain goals. The activities contributed by individuals are characterized as functional activities. Every organization is conceived of as being faced with the problems of coordinating the functional activities of individuals, allocating functional activities to individuals, and insuring that individuals continue to perform functional activities. The processes by which the organization meets these problems are characterized as, respectively, processes of coordination, processes of allocation, and processes of adaptation.

The empirical analysis is based on a study of a large government organization made by the Survey Research Center, and supported by a grant from the Office of Naval Research. One hundred and seventy-six professional and administrative personnel of this organization were interviewed in regard to their duties, and their attitudes toward their jobs and the organization.

Before the processes of coordination could be described it was necessary to examine the structure of the organization. The organization was split into an administrative section and an operating section, and these two sections had somewhat different structures. In both sections most individuals worked together in work groups. In the administrative section these work groups were coordinated with each other, and with the executive work group, through two individuals who were responsible for the integration of others. In the scientific section, on the other hand, work groups were more frequently coordinated with each other through informal contact between members of different work groups. These seemed to be two different processes of coordination: coordination through individuals in central positions, who were assigned responsibility for coordination of others; and informal coordination arising from the complementarity of activities allocated to different individuals.

A sub-population of individuals was used to examine processes of allocation. These individuals all had jobs in which the things absolutely required, the job imperatives, seemed to be the same. It was possible to consider both what factors created job imperatives, and to examine in detail what factors were associated with the allocation of optional role activities. The processes of allocation seemed to include: allocation based on the relation of the individual's office to other offices in a system of work operations, which formed the basis of the job imperatives; allocation by supervisory dictum; and allocation according to social sanction. In relation to allocation according to social sanction, individuals who had characteristics which were considered by their coworkers to legitimize their performance of an activity tended to perform the activity, while individuals who lacked these characteristics did not, other things being equal.

Processes of adaptation seemed of two sorts, according to whether they led to satisfaction with the job, or led to emotional withdrawal from the job. Either of these outcomes allowed the individual to continue to perform the task allocated to him. Satisfaction with the job was developed by most of the individuals examined whenever it was possible for them to see the job as contributing to them in an important way. The particular way in which the job contributed, however, was not fixed. Thus an individual in one job might emphasize the contribution the job made to his education while another individual with similar goals, in a different job, would emphasize the fact that the job allowed him to do important work, and thus put his training to good use.

A methodological appendix presents the mathematical basis for the analysis of the organization's structure. The concept of work group is based on the graph theory concept of component, the concept of contact between groups is based on the graph theory concept of bridge, and the concept of "liaison," or central, person, is based on the graph theory concept of articulation point.

168 pages. $2.10. MicA 55-1202

SOCIOLOGY, FAMILY

SOME SOCIO-ECONOMIC ASPECTS OF SELECTED NEGRO FAMILIES IN SAVANNAH, GEORGIA: WITH SPECIAL REFERENCE TO THE EFFECTS OF OCCUPATIONAL STRATIFICATION ON CHILD REARING

(Publication No. 11,409)

Joan Louise Gordon, Ph. D.
University of Pennsylvania, 1955

Supervisor: Dr. Ray H. Abrams

This study deals with the manner in which differentials in the occupational classification of the heads of Negro families in Savannah, Georgia are associated with and affect patterns of child rearing. It seeks to discover what differences in home ownership, income, marital status, family support, age at marriage, educational attitudes, church affiliation, and other social factors exist between 216 heads of Negro families engaged invarious occupations, who have children enrolled in the public schools and nursery schools of Savannah, Georgia, with special emphasis on varying patterns of child rearing existing at the different occupational levels.

In analyzing the data supplied by the interview method, the following conclusions became evident:

1. Differences in income, above the semi-skilled level are greater within each occupational stratum than between the occupational strata.
2. The husband's income as a wife employment factor is more pronounced when the husband's income is considered per se, without regard to his occupational level than when considered in terms of his occupational stratum.
3. The largest number of families supported by joint income of husband and wife comes in the professional group.
4. The greatest difference between the occupational strata in terms of home ownership is found in the proprietors group.
5. Age at marriage is a differential factor at the different occupational levels.
6. Church membership, at the different occupational levels, reflects heterogeneity rather than homogeneity.
7. There is no differential between the family heads, at the different occupational levels, as regarding median size of family.
8. With each descending occupational level of the family head, there is consistent decrease in the number of school years completed.
9. The marital status of the family head characterized by the absence of one of the marriage partners tends to influence the extent to which parental substitutes or adjuncts assume responsibility in child rearing.
10. Mother employment is a factor influencing the extent to which the grandmother assumes responsibility in rearing the child.
11. The findings do not support our hypothesis, that corporal punishment, is executed with less frequency in the professional group, regardless of the age level of the child, and tends to gain increase in usuage as the occupational hierarchy is descended.
12. At the different occupational levels, there is no impressive difference between the family heads with reference to those planning college for their children; however, there is a marked difference between the family heads planning academic training beyond college.
13. There is a lack of agreement, at the different occupational levels, with reference to parental willingness to let the child select his own life's vocation.
14. At the different occupational levels there is a high degree of consistency, with reference to the ages at which family heads would approve of their children dating.
15. There is consistent agreement, among the family heads, in the "white collar" occupations with reference to the ages at which they would approve of their sons marrying; family heads below this category vary from this general trend of agreement.
16. Above the unskilled group the majority of family heads prefer that their daughters marry individuals engaged in professional work.

The results, indicate that we may accept the hypothesis that, differences in the occupational level of the family head reflect differences in social and economic factors operating in the family.

The findings also lend assurance to the general conclusion that there is a functional relationship between the family head's occupational stratum and the manner in which he rears his child.

224 pages. $2.80. MicA 55-1203

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

BENEDICT DEBAR AND THE GRAND OPERA HOUSE IN ST. LOUIS, MISSOURI, FROM 1855 TO 1879

(Publication No. 9580)

Grant M. Herbstruth, Ph. D.
State University of Iowa, 1954

Chairman: E. C. Mabie

Since 1926, graduate students under the direction of Professor E. C. Mabie, Head of the Department of Speech and Dramatic Art at the State University of Iowa, have contributed a series of four doctoral dissertations and eleven master's theses designed to unfold the rich theatrical history of the river cities in the Midwest. The publication of William G. B. Carson's Theatre on the Frontier and Managers in Distress opened new avenues of research for the theatre historian, for through these two books the vast heritage of the St. Louis theatre gained stature and significance. At the suggestion of Mr. Mabie, four new doctoral dissertations were designed to continue the story so ably begun by Mr. Carson. The study at hand introduces the series with the activities of Benedict DeBar, who dominated the theatre in St. Louis from 1855 to 1879.

This dissertation was the outgrowth of a preliminary survey made by the author in the spring of 1952. The vast store of such primary source materials as public documents, letters, newspapers, theatre programs, prompt books, and recollections of men connected with DeBar's Opera House, convinced him that a continuance of the St. Louis story was vital to the annals of American theatre history. The purpose of this dissertation is three-fold: (1) to present an accurate, yet concise, record of Benedict DeBar and his activities as an actor and manager in St. Louis, (2) to fit this man and his theatre into the social, cultural, and economic setting of the time, and (3) to evaluate both in terms of specific contributions to the dramatic and cultural growth of the community. To accomplish this, the author has divided the work into six chapters. Chapter I presents a survey of theatrical growth in St. Louis prior to 1850. Chapter II introduces the reader to Benedict DeBar and concentrates on the architectural and decorative features of the physical theatre. Chapter III surveys the social setting and DeBar's specific audience situation. Chapters IV and V evaluate DeBar's Opera House as a first-class legitimate theatre through an analysis of the players, the plays, and the quality of production. The final chapter is devoted to summary and conclusions.

Boasting no theatrical heritage, Benedict DeBar with determination and devotion to a cause learned theatre from the inside. As an actor he rose from the ranks of mere walk-on roles to become the leading delineator in America of Shakespeare's Falstaff. During his apprenticeship he played the principal theatres of Great Britain and the United States, working with great theatre managers. Finally after a quarter of a century of practical theatre experience, he realized his ultimate goal, that of proprietorship.

The Civil War was instrumental in giving Benedict DeBar to St. Louis. Previously he had chosen that city for the express purpose of a summer theatre for his New Orleans company. With the outbreak of hostilities, however, he moved his headquarters to St. Louis, and for the rest of his life he used that city as the hub of his theatrical activities. Through his love of the theatre Benedict DeBar kept the legitimate drama alive in St. Louis during an era when variety shows, spectacles, and sensation pieces threatened to overwhelm it, and therein lies his principal contribution. Under his guidance stars of the greatest magnitude made their entrances and exits on the boards of the Opera House, many choosing his direction for the initial performances of their new plays. Adept at recognizing latent talents, DeBar launched many future stars on the way to success. In promoting the legitimate drama in St. Louis, he encouraged local citizens to test their skills in acting and playwrighting, and he worked in close harmony with the amateur groups of the city. In short, here was a man who dedicated his life to all that was fine in the world of the theatre.

Buffeted by two financial panics and a Civil War, DeBar found it increasingly difficult to meet his initial indebtedness, to pay the high salaries demanded by the stars, and still maintain a first-class legitimate theatre for a season of 38 to 43 weeks. With the rise of the combination he began to lose interest in his theatre, for the era which he loved, the era of the stock company, was coming to an end. After his death his theatres were sold at auction to satisfy the indebtedness which he had assumed in giving St. Louis a golden era of the theatre. Although financially unsuccessful, no mere monetary units can measure the contribution and artistic satisfaction which Benedict DeBar offered to the city of St. Louis.

1097 pages. $13.72. Mic 55-122

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

AMATEUR THEATRICALS IN ST. LOUIS, MISSOURI, 1875-1890

(Publication No. 9595)

Isabel Cecilia Thompson, Ph. D.
State University of Iowa, 1954

Chairman: Professor Edward C. Mabie

A survey of amateur theatricals in St. Louis, Missouri, 1875-1890, has included a resume of representative amateur entertainments and theatrical productions which disclosed a rise and decline of amateur activity reflecting the influences of the social and cultural trends of the period. The study is composed of the following:

1. Social and Cultural Scene, 1875-1890
2. Theatres and Halls
3. A Survey of Miscellaneous Amateur Entertainments, St. Louis, 1875-1890
4. History of the McCullough Dramatic Club
5. A Survey of Outstanding Dramatic Organizations; Social Dramatic, Educational and Operatic
6. Summary and Conclusions.

Although significant contributions had been made by the amateurs of St. Louis throughout its history, they had never achieved the prominence or recognition received during the period of the present study. At least fifty-three producing organizations can be accounted for during the fifteen years designated, the most outstanding being the McCullough Dramatic Club which was in existence from 1878-1887. Soon after its organization it absorbed a number of smaller clubs and continued to dominate the amateur scene until its exclusive membership began to decline in 1885, finally discontinuing activity at the end of its spring season in 1887.

The club was designed to appeal to an exclusive membership which gave it social prestige and attracted the support of some of the most distinguished citizens of the community. A remarkable versatility of interests and talents was displayed by a number of its members, the most celebrated being Augustus Thomas, who served his apprenticeship as a playwright with the club. They produced four of his early scripts, including Editha's Burglar, his first to receive a New York production.

One of the most vital contributions of the organization was the frequent production of plays written by amateurs. An over-all survey of plays and playwrights represented by the study revealed that the three most popular productions were written by amateurs, two of which were comic operas, a popular form of entertainment of the times.

A significant aspect of amateur activity of the period was the appeal which it held for the more fashionable elements of St. Louis society. The interest in amateur theatricals among that select circle exceeded that of their interest in the professional theatre. It was primarily due to their support and enthusiasm that amateur theatricals flourished for a period of approximately fifteen years. Towards the end of the period the changing social structure, lack of leadership, and poor organization accounted for the decline of amateur activity. The entire social scene was altered and amateur entertainment ceased to play the prominent role in the social life of St. Louis which it had for the previous ten or fifteen years.

Reference to the varied contributions made by distinguished citizens to amateur theatricals as well as to other cultural and civic activities has been made repeatedly throughout the study. The identification of prominent amateurs revealed a participation of social and civic leaders which lent dignity and prestige to the amateur endeavors. 611 pages. $7.64. Mic 55-123

ZOOLOGY

ELECTRON MICROSCOPE STUDIES ON THE NUCLEUS AND CHROMOSOMES OF SALIVARY-GLAND CELLS OF DIPTERA

(Publication No. 11,407)

Helen Gay, Ph. D.
University of Pennsylvania, 1955

Supervisor: Dr. C. W. Metz

Electron micrographs of smears of salivary-gland cells, obtained from third-instar larvae of Drosophila melanogaster, were used to determine the structure of the giant chromosomes, the pattern of organization of the nuclear membrane and the nature of nucleo-cytoplasmic inter-relations. Anderson's critical-point method was used to dry acetic-orcein smeared chromosomes so that electron micrographs could be prepared of the same type of preparation that has been studied extensively with the ordinary light-microscope. A method was devised for sectioning methacrylate-imbedded smears of salivary glands, which afforded better resolution of the internal structure of the giant chromosomes than was previously possible. In order to obtain ultra-thin sections of intact cells, the glands were fixed in a 1% buffered solution of osmium tetroxide and imbedded in n-butyl methacrylate. A method for obtaining an unlimited number of serial sections was devised and used to determine three-dimensional cellular relationships.

The observations on chromosome structure are consonant with the polytene theory of organization of

the salivary-gland chromosome. The electron micrographs suggest that the component chromonemata are relationally coiled in a hierarchy of coiled pairs; the smallest units, which are the most recently formed chromonemata, are approximately 500 Å in diameter. The bands of the salivary-gland chromosomes are presumably formed by the fusion of chromomeres.

In tangential sections, the nuclear membrane reveals a reticulate pattern of electron-dense material surrounding the so-called "pores," 500 Å in diameter, which are spaced approximately 1000 Å from center to center. Some of these "pores" show a dense, dot-like structure in the center suggesting a torus-like type of organization. In cross section, it can be seen that the nuclear membrane is composed of two electron-dense layers. The validity of interpreting discontinuities in these layers as complete perforations or "pores" is discussed.

The development and use of the serial sectioning technique made possible the determination of the nature of nucleo-cytoplasmic relations in functionally-active Drosophila larval salivary-gland cells. Outpocketings were observed on the nuclear membrane. They were always found adjacent to a highly differentiated part of a chromosome and sometimes contained dense chromosomal material that could be traced to a single component band of the chromosome. It is suggested that chromosomal activity is involved in the formation of these outpocketings of the nuclear membrane and that the blebs formed thereby are cast off into the cytoplasm where they contribute to the formation of such structures as endoplasmic reticulum and secretion granules.

201 pages. $2.51. MicA 55-1204

CYTOLOGICAL STUDIES OF CHROMIDIAL SUBSTANCE IN SPINAL GANGLION CELLS OF THE RAT FOLLOWING EXPERIMENTAL ALTERATION OF INTERMEDIARY CARBOHYDRATE METABOLISM

(Publication No. 11,506)

Julius Sidney Greenstein, Ph. D.
University of Illinois, 1955

The chromidial material present in fixed and stained preparations of nerve cell bodies is known to be a cytoplasmic nucleoprotein of the ribose type. Under conditions of mechanical injury, fatigue, excessive stimulation, disease, and a variety of stress situations this material undergoes the phenomenon of chromatolysis or dissolution which is a reversible process within limits.

The present study was undertaken to determine whether the neuron, which depends exclusively upon the chemical energy derived from glucose for its functional integrity, would display evidence of change in the amount and distribution of chromidia under conditions of experimentally altered carbohydrate metabolism.

Cells of the spinal ganglia were classified into three functional types based on their chromidial distribution. It was found by statistical analysis that these classes of cells are present within normal ganglia in relatively fixed proportions and these frequency distributions formed the basis comparison for the experimental groups.

Seven additional groups of rats were subjected to various endocrinological treatments: 1) alloxan injections, 2) insulin injections, 3) thyroxine injections, 4) thyroidectomy, 5) thiouracil feeding, 6) cortisone injections, and epinephrine injections. Application of statistical methods to the data accumulated from cytological studies applied to the ganglia of these treated groups provided convincing evidence that with respect to the differential count of the ganglion cells, there is a uniform reponse to the respective treatment and this response is significantly different, in each case, from the established frequencies of cell classes found in normal animals.

It is concluded that deviations in class frequencies from the normal proportions represent valid indices of a generalized response of the organism to changes in its total physiological makeup. The nature of the response, at the level of the ganglion, appears to be a function of the degree of specificity and severity of the stress involved.

124 pages. $1.55. MicA 55-1205

THE BIOLOGY AND ECOLOGY OF THE DIAMONDBACK MOTH, PLUTELLA MACULIPENNIS CURTIS, IN EASTERN ONTARIO

(Publication No. 9751)

Douglas George Harcourt, Ph. D.
Cornell University, 1954

Studies were made of the biology and ecology of the diamondback moth, Plutella maculipennis Curt., over a four-year period in the vicinity of Ottawa, Ontario.

The economic history, distribution, and synonomy of the insect are given. Descriptions and original illustrations of the stages are included.

The adults are nocturnal in habit. Cage observations indicate that mating and egg-laying occur on the first night subsequent to adult emergence. Oviposition occurs before midnight. The number of eggs recorded from captive females ranged from 11 to 188, with an average of 90.1. Egg-laying lasted about four days, the peak occuring on the first night of oviposition, except when temperatures were low.

Under field conditions, the number of eggs deposited on individual plants ranged from 0 to 111. The eggs were laid chiefly on the upper surface of the leaves. In 1,022 observations, the average incubation period was 5.7 days.

The adults were short-lived under cage conditions, the average female life-span being about eight days, that of the male about six days.

The larvae feed from the lower leaf surface, all the tissues being consumed except the veins and the

upper epidermis. Individuals of the first instar, however, mine in the spongy mesophyll layer. In 1,022 observations, the average duration of the larval instars was as follows: first instar, 4.0 days; second instar, 4.0 days; third instar, 5.0 days; and fourth instar, 5.6 days.

Pupation occurs on the host plant. The length of the prepupal period averaged 1.5 days, that of the pupal period 6.3 days. The length of the total developmental period ranged from 25 to 47 days, with an average of 31.6 days.

Temperature had a profound effect on the rate of development. The thermal constant for the egg stage was 83.8 day degrees F. and the threshold of developmental 46.5°F. The corresponding constants for the larval stage were 287.1 day degrees F. and 41.2°F., and for the pupal stage, 139.5 day degrees F. and 48.3°F.

The winter is passed in the adult stage. Seasonal history studies showed that five complete generations and a partial sixth occur at Ottawa. The first generation develops almost exclusively on wild Cruciferae.

An analysis of the lepidopterous caterpiller species complex attacking cabbage showed that on early cabbage the imported cabbageworm, Pieris rapae (L.), the diamondback moth, and the cabbage looper, Trichoplusia ni (Hbn.), were most numerous in the order named. On the late crop, the order of abundance was as follows: diamondback moth, imported cabbageworm, and cabbage looper.

Laboratory studies with larvae of the three species indicated that under normal conditions the true relative-feeding ratio of equal populations of the diamondback moth, imported cabbageworm, and cabbage looper is as follows:

1 : 7.5 : 11.6

The modification of a New Jersey Mosquito Light Trap to permit hourly captures of the diamondback moth is described. The peak of flight as determined by 3,140 captures was during the hourly period beginning a half hour after sunset. Numbers of each sex were taken in progressively decreasing quantity during the remainder of the night. Females dominated during the first two hourly periods of trap operation.

Temperatures at 8 P.M. (E.S.T.) were highly correlated with the nightly number of adults captured. The minimum flight temperature was 51° F. Captures increased almost linearily until an optimum temperature of about 74° F. was reached, at which point a significant reduction in flight intensity occured. Relative humidity and light rainfalls had little effect on the number of moths taken. Heavy rainfalls reduced captures.

Host preference studies with commerical varieties of cabbage indicated that the variety Red Acre was less attractive to the insect than were nine others. No host preference was shown when both cabbage and cauliflower were grown in mixed plantings.

Seasonal numbers of larvae were inversely correlated with the amount of rainfall. All stages are attacked by parasites and predators. A small erythraeid mite has been observed to feed on the eggs. Larvae and pupae are subject to the attack of a number of bird species. Larvae of the lace wing fly, Chrysopa sp., are capable of destroying prepupae in the cocoon.

Eight parasite species were reared from field-collected larvae and pupae. Horogenes sp., near plutellae (Vier.) and Diadromus plutellae (Ashm.) destroyed more than 50 percent of the viable cocoons. Of less importance were Tetrastichus sokolowskii Kurdj., Microplitis plutellae Mues., Habrocytus phycidis Ashm., Dibrachys cavus (Wlkr.), Euptero-malus sp. and Gelis tenellus (Say).

132 pages. $1.65. MicA 55-1206

A STUDY OF BAR MOSAICS PRODUCED BY AN UNSTABLE RING CHROMOSOME

(Publication No. 11,515)

Aaron Kurland, Ph. D.
University of Illinois, 1955

An unstable ring-chromosome stock of Drosophila melanogaster was employed to study the development of certain mutants of the Bar series.

The unstable ring was introduced into three stocks: white-Bar, white-Infrabar, and white-Infrabar-Bar. Cultures were maintained at 20°C, 25°C, and 28°C. All genotypes began development as heterozygotes for their Bar alleles. Frequently, the ring-chromosome bearing the normal gene for the Bar allele is lost during development. When this occurs in primordial eye tissue, the adult fly displays a white, or mosaic, patch in an otherwise red eye. This white area identifies eye tissue which is haploid for the Bar alleles originally in the heterozygote.

The facet number of mosaic eyes were recorded. When the white haploid areas were compared with facet counts of the entire eye, their relationship approximated the well known relative growth function:

$$y = bx^k$$

The k-values, or relative growth rates, were influenced by temperature much the same as might be expected from temperature-effect studies done by numerous other authors.

Assuming that the size of the mosaic area was inversely proportional to the time at which the ring chromosome was lost, a formula was derived in terms of facet numbers and growth rates:

$$W = (R - R')^{a_w/a_r}$$

W = facet number of white area in mosaic
R = facet number of eye with no mosaic
R' = facet number of red area in mosaic
a_w/a_r = ratio of growth rates of white/red.

The formula was tested by introducing the experimental data and plotting. The data behaved as the formula predicted.

In general, tandem duplications appeared to have higher relative growth rates than genotypes in which the gene appeared only once. This information, supplemented by experiments of other authors, furnished the foundation for a discussion of the possible mechanisms involved in the genic manifestations of the Bar alleles. 68 pages. $1.00. MicA 55-1207

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

A STUDY OF CYSTIC PHENOMENA AND OF MACRONUCLEAR MORPHOGENESIS IN STRAINS OF THE HETEROTRICHOUS CILIATE BLEPHARISMA UNDULANS STEIN

(Publication No. 11,519)

Donald Keith McLoughlin, Ph. D.
University of Illinois, 1955

The taxonomy of the genus Blepharisma Perty is reviewed, and the controversies that have arisen in the past regarding the identity of the various species are discussed. The several "key" characteristics of Blepharisma undulans Stein are considered, and their variability, especially evident for size and shape of the body, and in the structure of the macronucleus, is emphasized. In a revised description of B. undulans, based upon first-hand study of a number of strains, it is made clear that features which have been considered diagnostic in the past can be utilized only with cautious reservations.

The macronuclei of the various strains of Blepharisma undulans that have been studied are quite different from strain to strain. They range from a bipartite type to one composed of a dozen or more nodes. It is shown that in strains of B. undulans which possess a nodulated macronucleus there is a similarity in the events that occur during division. These include a loss of some of the chromatin material, a fusion of macronuclear nodes into two masses and a subsequent fusion of these two masses into one large, centrally located mass. This in turn elongates and divides into two daughter nuclei which either are nodulated at the time of separation or become so shortly after the division into daughter nuclei.

Many attempts to induce encystment in this organism were made. The most successful technique was found to be slow evaporation of the medium. This involves a number of associated factors and it is pointed out that this is only a method of obtaining cysts of this species and that the precise causes of encystment remain unknown.

Of the numerous techniques employed to induce excystment, two, a 1 percent horse manure infusion and a milk infusion, were found to be useful in experimentally inducing excystment. This again is only a method for obtaining excystment and is not an explanation of the factor or factors directly involved in inducing excystment.

The morphological changes that occur during encystment are described and a description of the cyst is given. 71 pages. $1.00. MicA 55-1208

A STUDY OF THE GULF FISHES IN THE VICINITY OF CEDAR KEY, FLORIDA

(Publication No. 11,483)

George Kell Reid, Jr., Ph. D.
The University of Florida, 1952

An investigation of the fishes which inhabit the extensive shallow areas and channels in the vicinity of Cedar Key, Florida, was made from June, 1950, through May, 1951. The muddy sand-bottomed "flats" supported rich growths of vegetation during the warm months and a varied and abundant fish fauna found food and shelter among the plants. Over 13,000 specimens were collected and 123 species representing 99 genera and 61 families are included in an annotated list. The kinds and numbers of fishes varied seasonally, the greatest variety of species and abundance of individuals being found during the summer and early fall. Breeding occurred generally during the spring months although some species spawned in the winter. Food studies indicated that microcrustaceans, malacostracans, shrimps, annelid worms, molluscs, crabs, and fishes were the principle food organisms utilized by the shallow water fishes. Of the environmental factors, salinity did not appear to be critical while water temperature and bottom composition seemed to exert considerable influence on the local fish population.

The Cedar Key fauna was found to consist mainly of species more characteristically associated with temperate climate. However, comparison with the fauna of Texas and North Carolina shows a considerably greater proportion of West Indian forms at Cedar Key. 259 pages. $3.24. MicA 55-1209

AN ANALYSIS OF THE BREEDING-BIRD POPULATIONS OF TROPICAL FLORIDA IN RELATION TO THE VEGETATION

(Publication No. 11,529)

William Beckwith Robertson, Jr., Ph. D.
University of Illinois, 1955

Objectives of the study were (1) to make an ecological analysis of the vegetation of the tropical area of Dade and Monroe counties, Florida; (2) to study the population density, relation to vegetation, and zoogeographic origin of the breeding land birds. Field work, done in the period June, 1950 – August, 1952 included 18 months spent in southern Florida, four weeks in Cuba, and two weeks in the Bahamas. Breeding-bird censuses were made during the 1951 and 1952 nesting seasons.

Geology, climate (including hurricanes), drainage, salt water encroachment, fire, and lumbering are discussed with particular consideration of the effects of these physical factors upon vegetation types. It is suggested that during the last glaciation, sea level fell lower than has been recognized. Climatic factors affecting vegetation are the south-north gradient of increasing frost frequency and the northeast-southwest gradient of decreasing annual rainfall and increasing length of the winter drought period. The importance of hurricanes in dispersal of land birds is questioned. Records summarized show that areas along south Florida coasts have recently become much more saline. The endemic flora associated with fire-maintained vegetation suggests that fire is a natural ecological factor.

Accounts of vegetation stress physiognomy, composition, and effects of fire for particular stands of pine forest, tropical hammock forest, bayhead forest, mangrove forest, Everglades marsh prairie, and coastal prairie, and include photographs and transect diagrams. Tropical hammock species invade pinelands and bayheads with fire acting to check this succession. Since drainage began, much of the southern Everglades has become subject to invasion by woody plants of the bayheads (Persea and its associates). The zoned communities within the mangrove vegetation and on beach ridges probably do not represent successional series. It is emphasized that present mosaic occurrence of vegetation types represents a natural equilibrium between successional tendencies and an environment including recurring fires and hurricanes. The importance of long-term successions uniting lowland and upland types through site elevation by peat deposits is questioned. There is no evidence that a uniform climax plant cover has existed in the region.

The closest Antillean counterparts of south Florida pine forests, tropical hammock forests, mangrove, and fresh water marsh communities are indicated. The Tertiary history in the southeastern United States of vegetation showing floristic resemblance to Florida tropical hammock and mangrove forests is traced. Biogeographical evidence suggests that the pine forest is a Pliocene segregate from the Madro-Tertiary flora. A new hypothesis of late Pleistocene to recent paleoecology states: (1) at the height of the last glaciation Florida Bay and the southern Everglades were a limestone upland with upland vegetation; (2) in the course of physiographic succession mangrove swamps and Everglades marshes have replaced upland communities.

Twenty-two breeding-bird censuses were made on 15 tracts by use of the Williams territory-mapping technique. Pine forest populations were: South Florida mainland (Long Pine Key) – 29 species, 45+ breeding pairs/100 acres (40 hectares); Lower Florida Keys (Big Pine Key) – 6 species, 5+ pairs/100 acres; northern Bahama Islands (Great Abaco) – 16 species, 92+ pairs/100 acres. Forest-edge populations were: South Florida mainland – 18 species, 102+ pairs/100 acres; Florida Keys – 12 species, 59+ pairs/100 acres. Two censuses of tropical hammock forest (Lignumvitae Key) showed 5 species and 18+ pairs/100 acres. Census of a mangrove island (North Nest Key) showed 14 species and 55+ pairs/100 acres. Grassland populations were: Everglades marsh prairie – 5 species, 4+ pairs/100 acres; coastal prairie – 6 species; 6+ pairs/100 acres.

Though South Florida land habitats are of West Indian character 85% of the breeding land birds are wide-ranging temperate North American species. The land avifauna is impoverished including only 29 native passerines (some of these rare and local) and lacking many land bird "types" (hummingbirds, swallows et al.) represented in both West Indian and southeastern North American avifaunas. Population densities are uniformly low in comparison with those found in other studies, and several habitats virtually lack breeding land birds. It is suggested that this situation can be explained only by reference to a continuum of climatic change and zoogeographical events. Evidence assembled indicates an early (Pleistocene?) southward invasion of the North American avifauna, which established populations of some 40 species in the West Indies, and a quite recent northward extension of the West Indian avifauna, with the establishment of eight species of West Indian land birds in South Florida. At present the region appears to be a hiatus between a North American land avifauna withdrawing before an unfavorable trend of climatic change and a West Indian land avifauna delayed in reaching suitable unoccupied niches by the presence of water barriers. 613 pages. $7.67. MicA 55-1210

A CONTRIBUTION TO THE MORPHOLOGY, TAXONOMY AND BIONOMICS OF THE EPIZOIC PERITRICHOUS CILIATE LAGENOPHRYS LABIATA STOKES, 1887

(Publication No. 11,536)

David Shomay, Ph. D.
University of Illinois, 1955

A loricate peritrich found to be one of the most common epizoic protozoa on three species of amphipods, Hyalella azteca (Saussure), Gammarus fasciatus Smith, and Crangonyx gracilis Smith, collected in Illinois, is considered to be Lagenophrys labiata Stokes 1887. It has been found on more than 90% of the individuals which were examined.

Measurements of the loricae of 100 individuals gave the following means and ranges: length, 67 microns (54-78), width, 66 microns (50-80). The height, measured for comparatively few individuals, averaged about 35 microns. Length/width ratios were similarly variable with 47% of the loricae found to be longer than wide, 35% wider than long, and 18% as long as wide. The aperture of the oval, transparent lorica, is bounded by a pair of prominent lips, each of which contains a single, thickened hemispherical ridge, ending in a small knob on each side. Sections show that the lorica is continuous ventrally.

The protoplasmic body contains an elongate, curved macronucleus, generally lying along the periphery of the body, and a single, small, oval micronucleus, usually quite close to the inner margin of the macronucleus. The peristomial disc bears a sinistrally winding ring of about 1 1/2 turns of cilia, and is borne on a contractile peduncle which permits its protrusion beyond the limits of the lorica aperture. A few cilia are found in the vestibule, and a single contractile vacuole is located near the cytopharynx.

Asexual reproduction involves the division of a trophic individual to produce a single swarmer which leaves the lorica and settles on a new location where it produces another lorica while metamorphosing into the adult structure. Lorica formation is similar to that of L. tattersalli Willis with the development of a "growth cavity" which results in the temporary increase of surface area, permitting the production of a

lorica larger than the protoplasmic body. Sexual reproduction is represented by conjugation. A vegetative individual produces two microconjugents which escape from the lorica to subsequently fuse with macroconjugents contained in other loricae.

The protozoa have been found on their crustacean hosts throughout the year, during wide ranges of temperature. The ciliates select, in order of preference, the gills, coxal plates, legs (especially the pleopods), and dorsal-lateral portions of the body for settling. When one area is occupied, the next suitable location is colonized. As the number of protozoa decline after a few months in laboratory culture, these portions of the hosts body are evacuated in approximately the opposite order. The constant motion of the gills and pleopods and their relatively thin integument, may explain the choice of these areas.

Although the numbers of ciliates on the amphipods may be enormously increased in laboratory culture, no deleterious effect on the crustacea has been detected. Efforts to induce transfer of the protozoa by culturing the amphipods with other crustacea including isopods, copepods, ostracods, and cladocera, have been unsuccessful, nor has the culture dish itself ever been utilized as a substrate. The idea of the wettability of the integument as a factor in determining specificity has been advanced in the past and appears to have some merit.

It has been found that the onset of molting of the host initiates a response on the part of this peritrich which results in the vegetative animal being liberated from its lorica, whereupon it reattaches either to the newly formed integument of the same host, or to a new host. As a result of this process, a small portion of the cytoplasm containing some nuclear material is generally left behind in the lorica. Presumably this response is mediated by the activity of the molting hormone(s) of the crustacean, a phenomenon which has been suggested for a few other protozoa associated with arthropods.

72 pages. $1.00. MicA 55-1211

EXPERIMENTAL STUDIES ON THE HOST-PARASITE RELATIONS OF POSTHARMOSTOMUM HELICIS (TREMATODA: BRACHYLAIMATIDAE) IN RODENTS

(Publication No. 11,364)

Henry Van Dyke, Jr., Ph. D.
University of Michigan, 1955

Four species of rodents (albino mice, albino rats, hamsters and deer mice, Peromyscus maniculatus) were subjected to experimental infections with the cecal fluke, Postharmostomum helicis (Leidy, 1847) Robinson, 1949. Albino mice were the principal definitive hosts employed.

Postharmostomum helicis grew most rapidly and attained sexual maturity earliest in Peromyscus maniculatus, a natural host. In albino rats Postharmostomum helicis grew more rapidly than in albino mice. P. helicis attained sexual maturity in albino rats about fourteen days after infection, whereas in albino mice these worms were sexually mature about twenty-one days after infection. Five weeks after infection fewer adults of P. helicis were recovered from albino rats than from albino mice. Hamsters were unable to tolerate an infection level that was readily tolerated by the other host species. In albino mice the size attained by P. helicis was independent of the number of flukes present.

Worms in female albino mice grew more rapidly than those harbored by males. The metabolic changes and physiologic demands of host pregnancy and lactation did not greatly alter the growth and development of Postharmostomum helicis. Lowered environmental temperature resulted in loss of weight and increased food consumption by the albino mice so exposed. Growth of P. helicis in such thermally stimulated host animals was not grossly different from that of worms in mice maintained at room temperature.

In albino mice a concurrent infection with oxyurid nematodes did not measurably alter the growth and development of Postharmostomum helicis. Albino mice exhibited age resistance toward this fluke. Worms in sexually mature rodents of this kind grew more slowly than those raised in younger individuals.

When tested twenty-five and sixty days after exposure to the initial infection of cecal flukes, albino mice demonstrated the acquisition of partial immunity against the adults of Postharmostomum helicis by retarding the growth of worms of the challenging infection. Immunity, as here expressed, did not seem to include regulation of the number of worms established.

Vitamin A or vitamin B-complex deficiency in albino mice caused stunting of Postharmostomum helicis but did not limit the number of worms established. Growth of cecal flukes in albino mice maintained on a high carbohydrate diet was much the same as that in animals on a normal diet. High protein and protein-deficient diets did not alter host receptivity for P. helicis in albino mice. Worms in animals maintained on either of the altered protein diets grew more slowly than flukes in individuals on a normal diet.

Fasting of albino mice also retarded worm growth for at the end of the four day fasting period Postharmostomum helicis in fasting mice were shorter than those in feeding animals. Fasting infected-mice died sooner than fasting non-infected-mice. No loss of weight, attributable to the blood sucking activities of this fluke, occurred in mice maintained on an adequate diet. 140 pages. $1.75. MicA 55-1212

CALCIUM UPTAKE IN HOMOGENIZED ORGANS FROM IMMATURE, ADULT, AND AGING RATS

(Publication No. 11,442)

Harry Weller, Ph. D.
University of Pennsylvania, 1955

Supervisor: L. V. Heilbrunn

The physiological importance of calcium with respect to cell permeability, cell division, stimulation and narcosis, and the activation of certain enzyme systems has been known for many years. In addition, a fundamental role for the element has been suspected in the processes of senescence and many studies have shown that changes in calcium content occur in animal organs with advancing age. The present studies were designed to determine whether or not tissues in aging rats show changes in the ability to bind calcium at the sub-cellular or cellular level. Such changes in calcium affinity, if demonstrated, could indicate a changing chemical structure in animal tissues as the animals age.

The uptake of calcium by the homogenized or minced tissues of rats was studied by the technique of equilibrium-dialysis. The results are based upon ten animals in each of four age groups: approximately 1 month, 5 months, 15 months, and 28 months old. The tissues used, namely heart, psoas muscle, kidney, brain, liver, and skin, were suspended in 0.005 M calcium chloride, buffered to pH 8.0, in dialysis sacs, and the sacs were immersed in buffered $CaCl_2$ of equal concentration. Calcium binding was measured as the amount of calcium that disappeared from the solution outside the permeable membrane after an equilibration period of 18-24 hours at about 5 ^{0} C.

The data, analyzed statistically, indicate a significantly higher level of calcium affinity in the organs of only the youngest age groups, on both a wet-weight and a dry-weight basis. These facts indicate that, under these particular experimental conditions, calcium binding in animal tissues is associated less with the processes of senescence than with those of active growth. They suggest, as well, that the chemical composition of the tissues of growing animals is subtly different from that of the tissues of adults, but that there is little or no difference between mature and senile individuals in this respect.

Other aspects of the present investigation show that the water content of the tissues studied does not change significantly throughout life except in the case of skin, which is notably more hydrated in the postnatal period. No significant correlation between calcium uptake (on a wet-weight basis) and tissue hydration was found, although on a dry-weight basis some degree of positive correlation exists between the two factors.

Spectrophotometric and chemical analyses indicated that calcium acts to reduce the solubility of certain unidentified, nitrogenous components of the homogenized system. The data suggest that a single, physically homogeneous, insoluble Ca-protein-nucleic acid complex may be formed upon the addition of calcuim ions. 63 pages. $1.00. MicA 55-1213

COMPARATIVE REPRODUCTIVE BEHAVIOR AND ECOLOGY OF FOURTEEN SPECIES OF DARTERS (PISCES - PERCIDAE)

(Publication No. 11,376)

Howard Elliott Winn, Ph. D.
University of Michigan, 1955

Thirteen species of darters were observed both in the laboratory and the field, largely in southern Michigan, and information on an additional species was taken from the literature. These fishes are Percina caprodes, Hadropterus maculatus, H. copelandi, Etheostome caeruleum, E. spectabile, E. saxatile, E. blennioides, E. microperca, E. (Ulocentra) sp. Barren River, E. (Ulocentra) sp. Green River, E. nigrum, E. maculatum and E. flabellare. In a few instances experiments on sex recognition and habitat selection were conducted.

The habitat, associates, sexual dimorphism, sex ratio, migration, reproductive period, territory, courtship, spawning act, care of eggs, sex recognition, eggs and age at maturity are compared among the various species. Experiments on egg-site selection with E. blennioides showed that algae are selected for egg deposition because of their textural qualities. Stimulatory behavior and reproductive synchronization are discussed.

These fishes exhibit a wide diversity in behavior, ecology and morphology. The data in each of the following statements are arranged in an approximate phylogenetic sequence. The species vary as follows: from use of lake shores to almost every conceivable stream microhabitat; from 9 to 2 cm long; from slight to strong sexual dimorphism in color, body size and fin structure; from inefficient to unmistakable sex recognition; from no territory, to a moving territory around the female, and finally to a stationary territory centered around a plant or large rock; from an intraspecific to an interspecific defense of the territory; from a horizontal spawning position to an obtuse angle in relation to the substrate, with the male on top of the female, and finally to an upside-down position with the male beside the female; from deposition of eggs in sand, in gravel, on algae, on aquatic flowering plants, and over rocks to the undersurface of rocks; from an average deposition of 2000 to 200 eggs by a two-year-old fish; from laying of many eggs to only one in a single spawning act; and finally, the continuous laying of eggs throughout 8 weeks to the laying of 5 or 6 large clutches in 4 weeks.

Certain aspects of the limiting factors of the population, sexual selection and the selective value of territorial and associated behavior are briefly considered. Finally, a phylogeny of behavior based on the above considerations is presented.

Several major conclusions drawn from the study are as follows. (1) Spatial and temporal utilization of the microhabitats among darters and other fishes are so arranged that competition is negligible. (2) The more striking sexually dimorphic structures are related to complex behavior. (3) The complex spawners breed later in the spring when there are slower and less turbulent currents. (4) Both territorial and

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schooling societies are developed to various degrees in the darters. Males of certain darters need the presence of another male of their own species at critical periods in order to express pugnacious behavior. (5) Contact between males and other aspects of behavior maintain the fish in a sexually ready state. (6) The organization of the schooling and territorial societies is considered to be the first step in reproductive synchronization, which is finally accomplished by the "following," "copulatory" and "vibratory" reactions. (7) There is a close correlation between behavior and morphology, especially between sex recognition, territoriality, sexual dimorphism, and the relative size of sexes. (8) Increased care is correlated with a decreased number of eggs laid. (9) The amount of available nesting grounds controls the size and local distribution of most stream populations of darters. (10) Finally, trends in behavior are so marked that a phylogeny of behavior can be reasonably presented.

The darters are so abundant, in species and individuals, and exhibit such a wide variety of breeding habits, that they are an excellent tool for the comparative study of behavior and ecology.

243 pages. $3.04. MicA 55-1214

THE AMERICAN CAMAENIDAE

(Publication No. 11,444)

Charles B. Wurtz, Ph. D.
University of Pennsylvania, 1955

Supervisor: Dr. H. B. Baker

This study is based on the comparative anatomy of all the species of American Camaenidae available. The discussion is based on all the gross morphology of the snail. Emphasis is placed on the anatomical information that appears to be of systematic value.

Two subfamilies, Ammonitellinae and Oreohelicinae, placed in the Camaenidae by Pilsbry are deleted from the family. They are considered to be distinct families.

The classification, and the chief characters of the genera, follow:

Caracolus Montfort. Characterized by numerous, small, ovoid alveoli in the ovotestis; no talon; epiphallus recurved toward the atrium; and penial complex without verge or accessory organs. The subgenera are Isomeria s.s. and its other section Ambages, Labyrinthus, and Caracolus s.s.

Pleurodonte Fischer de Waldheim. Characterized by numerous, digitiform alveoli in the ovotestis; talon present; and with a penial verge. The subgenera are Eurycratera, Pleurodonte s.s. and its other section Dentellaria, and Thelidomus.

Polydontes Montfort. Characterized by few, elongate alveoli in the ovotestis; no talon; and with a penial verge as well as accessory structures on the penial complex. The subgenera are Parthena, Granodomus, Luquillia, Polydontes s.s., Hispaniolana, and Lissembryon.

Coloniconcha Pilsbry. This genus is known only from the shell, which is distinctly vitriniform.

Zachrysia Pilsbry. Characterized by few, long, flagellate alveoli in the ovotestis; spermathecal stalk rising from the atrium; presence of an atrial retractor muscle; and the right ocular retractor not passing through the penioviducal angle. The subgenera are Zachrysia s.s., Torreychrysias, Megachrysia, Chrysias, and Auritesta.

Separate sections on each major part of the anatomy deal with the characters of systematic value. The anatomical sections include the genitalia, the retractor muscles, the pallial complex, the alimentary system, the central nervous system, the integumental pigment pattern and the shell.

The work is illustrated by 136 anatomical drawings pertaining to 52 species and subspecies.

132 pages. $1.65. MicA 55-1215

EXPERIMENTS ON FEEDS AND RATES OF FEEDING FOR THE COMMON CARP, CYPRINUS CARPIO LINNAEUS, IN TROUGHS

(Publication No. 11,676)

Abdul Rahman Khan Zobairi, Ph. D.
Alabama Polytechnic Institute, 1955

Director: Homer S. Swingle

Results of the laboratory experiments on feeds and rates of feeding for the common carp, Cyprinus carpio Linnaeus, are given. Feeding was done in stainless steel troughs indoors which were supplied with flowing tap water at a temperature of 80°-86° F. Eleven different feeds were tested in terms of the weekly rates of growth of the carp. The rate of feeding was calculated as a percentage of the body weight of the fish. The different rates of feeding tested were: 1.0, 2.0, 2.5, 5.0, and 7.0 per cent of the body weight per day.

The most efficient rate of feeding appeared to lie between 2.0 and 5.0 per cent of body weight per day. Conversion of food into body weight was inefficient outside this range.

Of all the diets tested, a mixture of "Perk" and peanut meal (1:1) was found to be the best. Next in order came one of peanut meal plus soybean cake plus fish meal in the ratio of 5:5:1 or 4.5:4.5:2. Beef liver alone, possibly because of its high moisture content, did not produce adequate growth even when fed at 5.0 per cent of body weight per day.

Fish meal improved weekly weight increments when added to peanut meal in the proportion of approximately 9 per cent of the total feed. However, this diet, when fed at the rate of 2.5 or 5.0 per cent of body weight per day, caused two types of avitaminosis among the carp. One was characterized by the extreme excitability of nervousness of the fish, loss of equilibrium, disintegration of the fin membranes and opaque cornea and the other by a "pop-eye" condition. The former type of the disease was cured by injecting intraperitoneally 1 mg. each of a mixture

of either pyridoxine, calcium pantothenate, and folic acid or of riboflavine, vitamin B_{12}, and choline. An injection of thiamin, even as much as 5 mg. per fish, did not cure this type of avitaminosis. The "pop-eye" condition was completely cured by injecting intraperitoneally 1 mg each of pyrodoxide, calcium pantothenate and folic acid in a mixture. Injecting folic acid or riboflavine alone did not cure or even alleviate this disease.

Marking fish by clipping one of their pectoral fins did not seem to affect the growth of the fish. Complete regeneration of fins occurred approximately every four weeks.

116 pages. $1.45. MicA 55-1216

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